MARCH 1955

Journal

VOL. 47 • NO. 3

AMERICAN WATER WORKS ASSOCIATION

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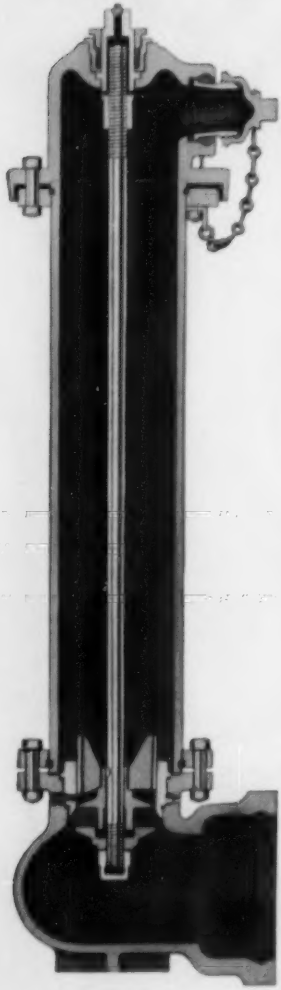
COSTS LESS TO INSTALL
COSTS LITTLE TO MAINTAIN



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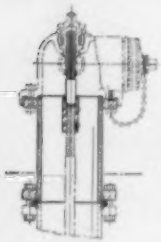

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Journal AWWA is published monthly at Prince & Lemon Sts., Lancaster, Pa., by the Am. Water Works Assn., Inc., 521 Fifth Ave., New York 17, N.Y., and entered as second class matter Jan. 23, 1943, at the Post Office at Lancaster, Pa., under the act of Aug. 24, 1912. Accepted for mailing at a special rate of postage provided for in paragraph (d-2), Section 34.40, P. L. & R. of 1948. Authorized Aug. 6, 1918. $7.00 of members' dues are applied as a subscription to the JOURNAL; additional single copies to members—60 cents; single copies to non-members—85 cents. Indexed annually in December; and regularly by *Industrial Arts Index* and *Engineering Index*. Microfilm edition (for JOURNAL subscribers only) by University Microfilms, Ann Arbor, Mich.

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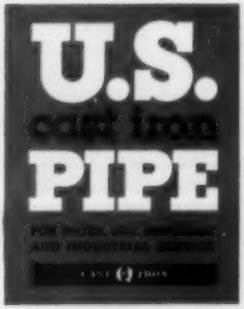

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Coming Meetings

AWWA SECTIONS

Apr. 13–15—Nebraska Section at Cornhusker Hotel, Lincoln. Secretary, E. Bruce Meier, Asst. Prof. of Civ. Eng., Univ. of Nebraska, Lincoln.

Apr. 13–15—Kansas Section at Baker Hotel, Hutchison. Secretary, Harry W. Badley, Repr., Neptune Meter Co., 119 W. Cloud St., Salina.

Apr. 14–16—Arizona Section at San Marcos Hotel, Chandler. Secretary, Quentin M. Mees, Arizona Sewage & Water Works Assn., 721 N. Olsen Ave., Tucson.

Apr. 18–20—Canadian Section at Chateau Frontenac, Quebec. Secretary, A. E. Berry, Director, Ontario Dept. of Health, Parliament Bldgs., Toronto 8, Ont.

Apr. 20–22—New York Section at Hotel Statler, Buffalo. Secretary, Kimball Blanchard, Rensselaer Valve Co., 56 Grand St., White Plains.

Apr. 29–30—Montana Section at Finlen Hotel, Butte. Secretary, A. W. Clarkson, Acting Chief, Water Section, Div. of Environmental Sanitation, State Board of Health, Helena.

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AWWA ANNUAL CONFERENCE

Chicago, Ill. **June 12-17, 1955**

All reservations are being cleared through the AWWA office. The Conrad Hilton Hotel has agreed to accept no reservations for the 1955 Conference except as they are requested on the standard form, through the AWWA.

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Coming Meetings

(Continued from page 6)

May 4–6—Pennsylvania Section at Webster Hall, Pittsburgh. Secretary, L. S. Morgan, Div. Engr., State Dept. of Health, Greensburg.

May 19–21—Pacific Northwest Section at Hotel Chinook, Yakima, Wash. Secretary, Fred D. Jones, Dist. Supervisor, Rm. 305 City Hall, Spokane, Washington.

Sep. 7–9—New York Section at Saranac Inn, Saranac. Secretary, Kimball Blanchard, Rensselaer Valve Co., 56 Grand Street, White Plains.

Sep. 12–14—Kentucky-Tennessee Section at Phoenix Hotel, Lexington, Ky. Secretary, J. Wiley Finney Jr., Howard K. Bell, 553 S. Limestone St., Lexington.

Sep. 14–16—Michigan Section at Durant Hotel, Flint. Secretary, T. L. Vander Velde, Chief, Section of Water Supply, State Dept. of Health, Lansing 4.

Sep. 19–21—Rocky Mountain Section at Connor Hotel, Laramie, Wyo. Secretary, J. W. Davis, Dist. Mgr., Transite Pipe Div., Johns-Manville Sales, Inc., Denver, Colo.

Sep. 21–23—Ohio Section at Neil House, Columbus. Secretary, M. E. Druley, Dist. Mgr., Dayton Power & Light Co., Wilmington.

Sep. 21–23—Wisconsin Section at Hotel Schroeder, Milwaukee. Secretary, Leon A. Smith, Supt., Water & Sewerage, City Hall, Madison 3.

Sep. 25–27—Missouri Section at the Connor Hotel, Joplin, Mo. Secretary, W. A. Kramer, Room 3, 6th Floor State Office Bldg., Jefferson City, Mo.

OTHER ORGANIZATIONS

Mar. 28–Apr. 1—Western Metals Exposition, Pan-Pacific Auditorium, Los Angeles, Calif.

Apr. 5–7—Corrosion Control Short Course, Univ. of Oklahoma Extension Study Center, Norman, Okla.

Apr. 13–15—Conference on Biological Waste Treatment, Manhattan College, New York 71, N.Y.

May 1–5—Municipal Finance Officers Assn., Jung Hotel, New Orleans, La.

May 15–19—European Assn. for Research on Fluoridation and Caries Control, Univ. of Geneva College of Dentistry, Geneva, Switzerland.

Jul. 11–16—Nuclear Engineering Congress, Engineers Joint Council, New York.

Jul. 18–23—International Water Supply Assn. Congress, London.

Sep. 18–22—New England Water Works Assn., Lake Placid Club, Lake Placid, N.Y.

Oct. 10–13—Federation of Sewage & Industrial Wastes Assns., Ambassador Hotel, Atlantic City, N.J.

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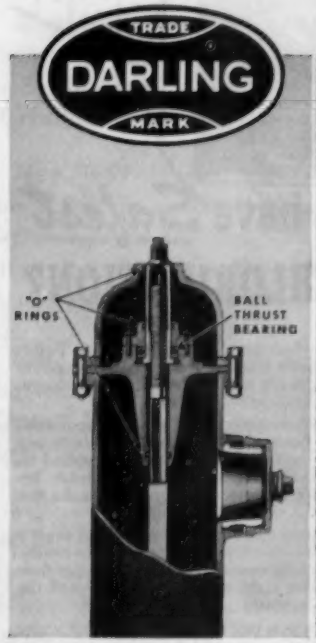

A. W. Grathwol, manager of the Sandusky, Ohio, Water Distribution Department, checking static water pressure on a newly installed Darling B-50-B hydrant.

Word is getting around about DARLING'S NEW B-50-B FIRE HYDRANT

WATER distribution men like A. W. Grathwol of the Sandusky, Ohio, Water Distribution Department, are spreading the good news about the new patented Darling B-50-B fire hydrant. It rates as the most important fire hydrant advance in 50 years.

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2. The Darling B-50-B is a *ball-bearing* operated hydrant. Opening and closing takes less than half the usual wrench torque.

And you also get another long-time advantage of Darling hydrants . . . all inside working parts, including the main valve seat and drain valve seats, can be removed through the top *by one man* for on-the-spot inspection and maintenance. Write for Bulletin No. 5007 before you decide on any hydrant. Address . . .

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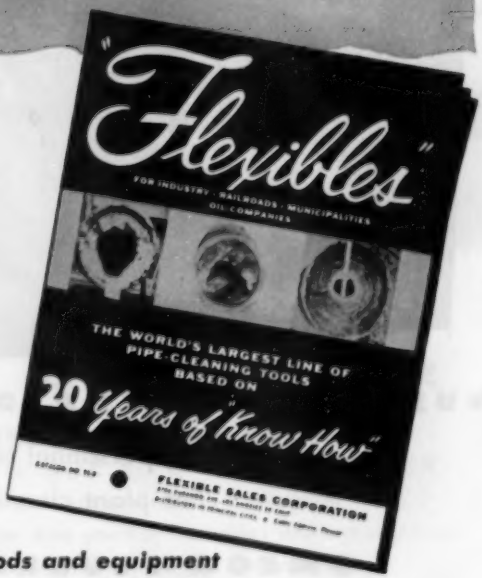
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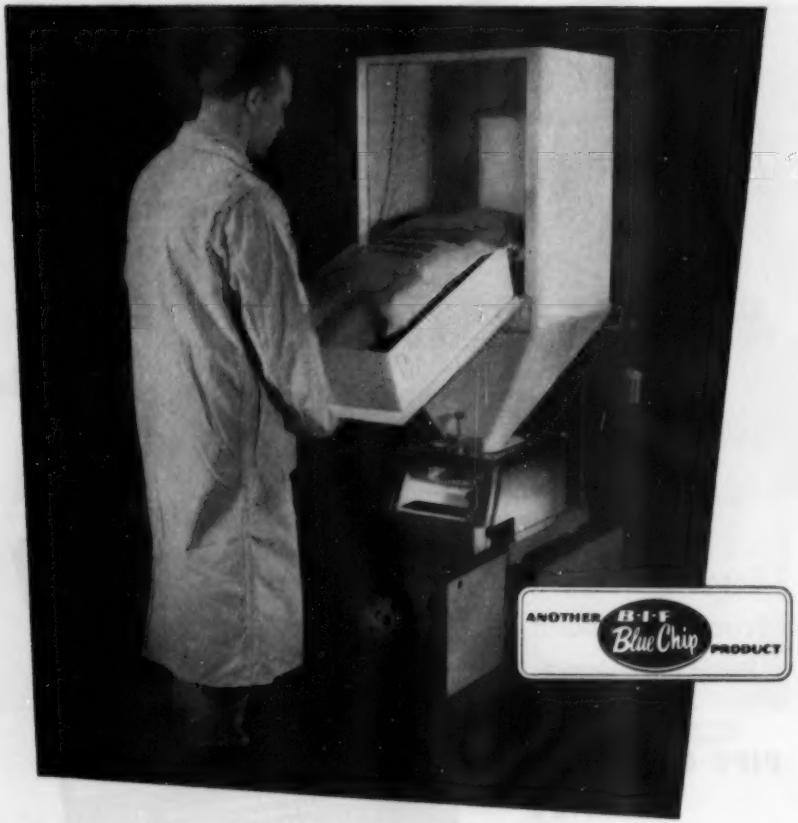

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...AND STRONGER WHEREVER STEEL PIPE IS USED TO CARRY WATER

Solid strength where other materials are weakest—this characterizes steel pipe. Consider these points of steel pipe's structural superiority: Greater tensile strength—outstanding ductility—rugged elasticity—shatter-proof toughness. And—as if these points aren't enough, every section of steel pipe is hydrostatically tested to *twice* the required working pressure. Small wonder why you're smart to specify steel water pipe!

"WHEREVER WATER FLOWS — STEEL PIPES IT BEST"

STEEL PLATE FABRICATORS ASSOCIATION

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Stopping Corrosion

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Electrolytic corrosion is the malignant destroyer of buried or submerged metallic structures and pipelines. Unlike the dreaded human malady, *it can be cured!* That's our business. We are "Doctors for Metals" . . . specialists who can prevent or cure electrolytic corrosion quickly and economically. In fact, the cost of a HARCO cathodic protection system can be reclaimed within a few months . . . through savings in normal maintenance and replacement costs.

HARCO supplies a complete range of services. Whatever your needs . . . job-engineered systems, contract installations or cathodic protection materials . . . look to HARCO, *first in the field of cathodic protection.*

Write today for catalog or call MOntrose 2-2080.

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CATHODIC PROTECTION DIVISION

THE HARCO CORPORATION

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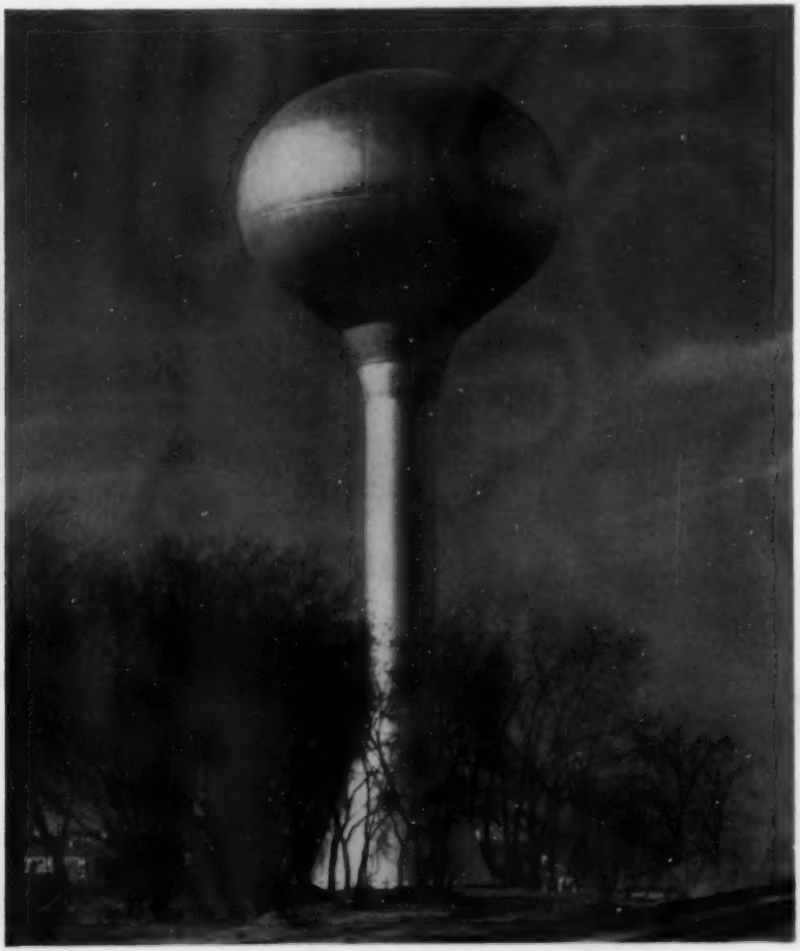

Horton Waterspheroid At Northbrook

The first Waterspheroid ever built was erected for Northbrook, Illinois, to provide dependable gravity water storage for general service and fire protection. The tank with a diameter of 55 feet, 6 inches has a range in head of 37 feet 6 inches, and a height to the high water line of 135 feet.

CHICAGO BRIDGE & IRON COMPANY

Plants in Birmingham, Chicago, Salt Lake City, and Greenville, Pa.

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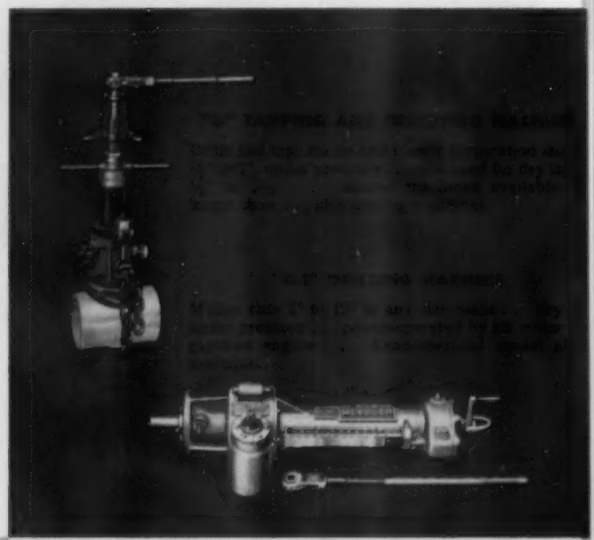
In Canada—HORTON STEEL WORKS, LIMITED, FORT ERIE, ONT.



Standardize on

MUELLER

A COMPLETE LINE OF WATER WORKS EQUIPMENT

Low maintenance and high efficiency are characteristic of all Mueller water works equipment, supplies and specialities. Each item is engineered to do its specific job and is manufactured from the finest materials — guaranteeing long, trouble-free life. A high degree of standardization and interchangeability requires a minimum inventory of replacement parts in case of accident or emergency. Mueller's complete line of products, a few of which are shown, provides a single source for your water works needs. All products are fully tested and warranted.

CORPORATION STOPS

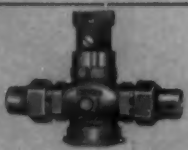
Designed for insertion into mains under pressure . . . ground key . . . complete range of sizes and types . . . variety of inlet and outlet threads and connections.

SERVICE CLAMPS

For use on all types of pipe . . . single or double strap . . . full depth tapped hole . . . Neoprene or lead ring gasket . . . all sizes and threads available.

CURB BOXES

Telescoping type . . . prevents damage to stop or piping . . . large steel upper section will not revolve in base. Bronze-to-iron threads for easy plug or lid removal . . . with or without stationary rod.



CURB STOPS

Ground key stops . . . proper taper prevents sticking . . . allows easy operation . . . inverted key or solid tee head type . . . complete range of sizes, types and connections.

METER SETTING EQUIPMENT

Copper meter yoke with multi-purpose end connection . . . iron meter yokes . . . plain or lock wing angle stops . . . meter couplings . . . complete line available . . . variety of inlets and outlets.

REGULATORS AND RELIEF VALVES

Large diaphragm type . . . all working parts accessible without removing from line . . . high or low pressure . . . for water, air, gas or oil.

FIRE HYDRANTS

AWWA improved and standard types, sizes to 6¼" valve opening . . . compression type . . . locked-in nozzles . . . safety flange minimizes collision damage . . . 2½", flush type and Underwriter Approved also available . . . AWWA.

GATE VALVES

Exclusive "four-point contact" disc wedging mechanism . . . fully bronze-mounted . . . conventional or "O" ring stem packing . . . rising or non-rising stem . . . AWWA.

INSERTING VALVES

Designed for installing in line without a shutdown . . . operated like gate valve after installation . . . parts interchangeable with AWWA gate valve . . . 4", 6" and 8" sizes.

MUELLER CO.

Dependable Since 1857

MAIN OFFICE & FACTORY DECATUR, ILLINOIS

. . . by protecting pipelines with Bitumastic® 70-B Enamel

● There are two ways to buy steel pipe for large-diameter water lines. One method is expensive—the other economical. You can buy *over-sized* pipe to allow for future loss in flow capacity caused by tuberculation and incrustation . . . or you can buy *smaller* pipe solely on the basis of desired capacity and then prevent "shrinkage" by using Bitumastic 70-B Enamel.

Flow capacity *stays* high when a spun lining of Bitumastic 70-B Enamel protects interior surfaces against rust, corrosion, incrustation and tuberculation. Flow tests, conducted on steel pipelines, centrifugally lined with hot Bitumastic 70-B Enamel, have shown the value of Hazen-Williams coefficient "C"=145 to 170—the average being 155.

On wall thickness, too, you can save on steel by using Bitumastic 70-B Enamel. Applied to a thickness of approximately 1/16", this durable enamel protects the exterior of pipe against the corrosive action of the soil. There's no need to specify an excess of wall thickness to compensate for corrosion. Just specify enough wall thickness to give the pipe adequate structural strength and then use Bitumastic 70-B Enamel to prevent corrosion.

Use strong, durable steel pipe, lined and coated with Bitumastic 70-B Enamel. It's a good combination—an economical combination. Write for full information.

KOPPERS BITUMASTIC ENAMELS ®

KOPPERS COMPANY, INC.

Tar Products Division, Dept. 305-T, Pittsburgh 19, Pennsylvania

DISTRICT OFFICES: BOSTON, CHICAGO, LOS ANGELES, NEW YORK, PITTSBURGH, AND WOODWARD, ALA.

Triangle Brand Copper Sulphate

HELPS SOLVE YOUR WATER PROBLEMS

Triangle Brand Copper Sulphate economically controls microscopic organisms in water supply systems. These organisms can be eliminated by treatment of copper sulphate to the surface. Triangle Brand Copper Sulphate is made in large and small crystals for the water treatment field.

Roots and fungus growths in sewage systems are controlled with copper sulphate when added to sewage water without affecting surface trees.

Booklets covering the subject of control of microscopic organisms and root and fungus control will be sent upon request.

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40 Wall Street, New York 5, N. Y.
230 N. Michigan Ave., Chicago 1, Ill.

WATER Paces Lakeland's Business Growth!

Allis-Chalmers Helps 'World's

THE "WORLD'S CITRUS CENTER" is being helped by Allis-Chalmers in the race to keep water works ahead of population growth. In ten years, Lakeland's population has increased 70 percent, meters have doubled, and gallonage pumped has nearly tripled!

Lakeland is so named because of the 12 lakes within its city limits. It is near the geographical center of Florida, in Polk county . . . producer of a third of all Florida citrus, two thirds of U. S. phosphate, and more cattle than any other county in the state.

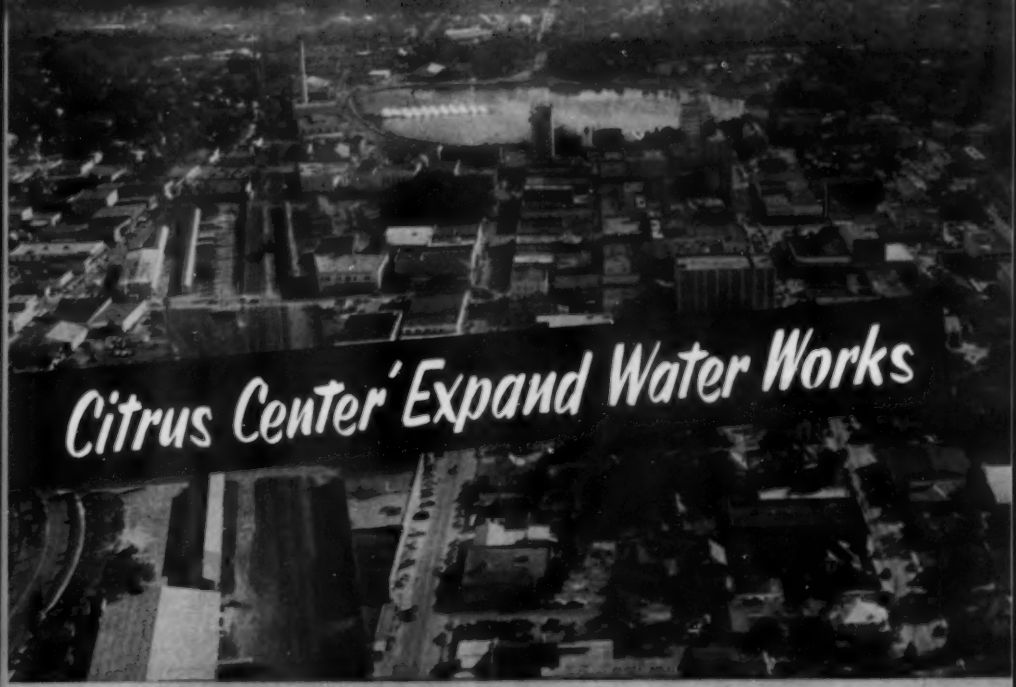
Lakeland has learned by experience the wisdom of depending on Allis-Chalmers for a complete range of public works equipment. Some of their A-C equipment has been in operation for over 30 years and maintenance has been "practically nil." A-C equipment at Lakeland ranges from three turbine-generators through transformers, m-g sets, and controls to motors and pumps of many sizes.

When *your city* plans expansion or modernization, do as Lakeland and other leading cities are doing — take advantage of Allis-Chalmers experience as builder of the world's widest range of public works equipment. Literature on all products available; Public Works Bulletin 25C6607A and Pump Bulletin 08B6146B just off the presses. For your copies, just call your nearest A-C sales office or write to Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4221

POWER TRANSFORMERS were furnished by Allis-Chalmers. Those above are 833 kva, single phase, self-cooled units in Lakeland suburban substation. Other electrical equipment supplied includes controllers for the 150 hp deep well pump motors.

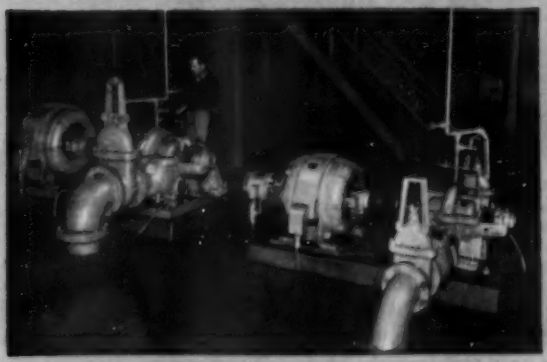
NEW POWER HOUSE features Allis-Chalmers 20,000 kw steam turbine generator unit. In addition to the steam turbine, hydrogen cooled generator, main and pilot exciters, and hydrogen control equipment, A-C also furnished the three 6x4 in., 450 gpm, 1150 psi boiler feed pumps.

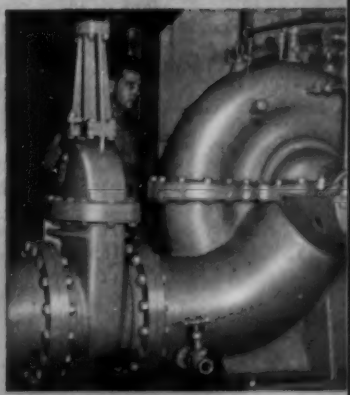


Citrus Center Expand Water Works

LAKELAND FROM THE AIR, looking east. Over 600,000 people live in a 50 mile radius from Lakeland, Fla. Old power house, containing two Allis-Chalmers 5000 kw steam turbine generator units and associated equipment, is on left shore of Lake Mirror in center of above photograph.

CITY MAINS ARE SUPPLIED by Allis-Chalmers pump-motor teams ranging in capacity from 2000 to 4000 gpm each. Typical setup shown below: at left is a 12 x 10 in. pump rated 4000 gpm at 160 ft head, driven at 1800 rpm by 200 hp motor. At right is a 2000 gpm, 8 x 8 in. pump driven by a 100 hp, 1800 rpm synchronous motor.





PUMPS RANGE IN SIZE from 1¼ x 1¼ in. to this 16 in., 6000 gpm, 16 ft head unit furnishing condenser cooling water in old power house. Here Allis-Chalmers supplied two 5000 kw steam turbine generator units, boiler feed and condenser circulating water pumps, and crane m-g set.

ALLIS-CHALMERS

Builders of the World's Widest Range of Public Works Equipment

Roberts Filter *means...*

MUNICIPAL WATER PURIFICATION

The combined capacity of Roberts-equipped filtration plants is well over 5 billion gallons (5,000,000,000) per day. Regardless of the size of the plant or the nature of the filtration problem, Roberts Filter can be depended upon for equipment that is reliable in years of service.

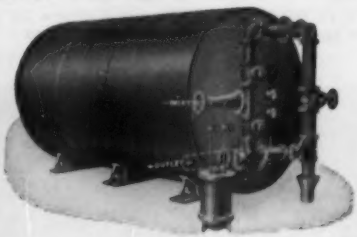
INDUSTRIAL WATER RECTIFICATION

Water treatment has long been a specialty of Roberts Filter. Zeolite water softeners are guaranteed to meet all requirements for which recommended, and are available in a wide range of capacities. Roberts water conditioning equipment is widely used to control precisely the desired chemical content of water for industrial use.

SWIMMING POOL RECIRCULATING SYSTEMS

The combination of thoroughly clarified water and efficient recirculation are features for which Roberts pools are famous. Systems for both outdoor and indoor pools are designed and installed by men long experienced in the conditions peculiar to a successful swimming pool installation.

PRESSURE FILTERS



Closed pressure filters have wide usage where gravity filters are not justified. Roberts vertical filters are available in standard types from 12" to 96" diameter; horizontal pressure filters are all 8'0" in diameter and in varying lengths from 10'0" to 25'0".

When you think of good water—think of Roberts Filter

Roberts Filter

Manufacturing Company • Darby, Penna.

When you buy HYDRANTS and VALVES for your city waterworks system...

LOOK TO THE YEARS AHEAD, TOO!

EDDY can supply replacement parts for any Eddy Valve or Hydrant ever installed! This is important to you because the Valves and Hydrants you buy today must serve several generations yet unborn. You want no "orphans" in your system. Eddy Hydrants and Eddy Valves are backed by Eddy Valve Company's 104 years of dependable operation—your assurance that replacement parts will be available during the years to come.

EDDY Bronze-Mounted HYDRANTS are built for dependability and lasting service. They open smoothly *with* the pressure and close without water hammer. One man can easily remove all operating mechanism for inspection and repair. Positive drip action automatically drains the standpipe, safeguarding against freeze-ups. Stem held in place below main valve means no water loss due to a bent stem.

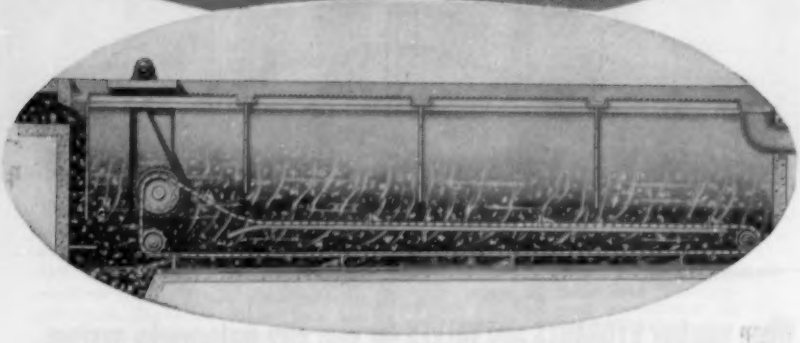
EDDY Bronze-Mounted GATE VALVES offer simplicity of design, trouble-free operation and enduring service. From the engineering drawing boards through all stages of manufacture, they are step by step a truly "finished" product of workmanship. These factors, added to personal experience, are reasons why progressive water works men have relied on Eddy Valves for years.

Eddy Hydrants and Valves are available with bell, flange or mechanical joint connections to fit any existing or planned installation.

Send today for full information on the complete line of Eddy Valves and Hydrants. No obligation.

EDDY VALVE COMPANY
A Subsidiary of James B. Clow & Sons
WATERFORD, NEW YORK

Now There's PROOF
That REX® VERTI-FLO® will
INCREASE plant capacities
CUT installation and operating costs



Yes, the unique cellular construction of Rex Verti-Flo that provides maximum practical weir length is now an established, proven principle in clarifiers... proved in more than 20 installations with more going into operation soon! It has more than lived up to our claims... just check any user. We'll gladly supply the names if you desire.

So, if you're interested in at least doubling your present plant capacity or substantially reducing costs of a new installation, be sure to consider Rex Verti-Flo.

Check these VERTI-FLO advantages for your plants:

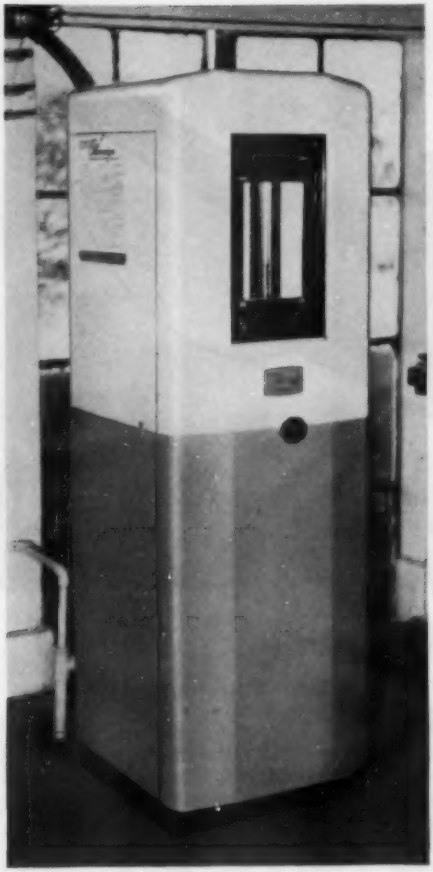
- Detention periods ¼ to ½ shorter than those required in conventional tanks... tank sizes ¼ to ½ of those normally used.
- Completely adaptable for varying rates of flow.
- Virtually eliminates short circuiting.
- Provides flexibility of flow distribution.
- Allows sludge recirculation.
- Maximum clarity of effluent.

For the complete Verti-Flo story send for your copy of Bulletin No. 52-77. Write Chain Belt Company, 4609 W. Greenfield Ave., Milwaukee 1, Wis.

CHAIN BELT COMPANY

District Sales Offices in all principal cities.

EXPORT Offices: 4800 W. Mitchell St., Milwaukee; and 19 Rector St., New York City



CHLORINIZER gets vote of confidence at Denver, Colorado

On June 11, 1951, this Model CVS Builders Chlorinizer was installed and placed in service entirely by the plant operators at Denver's 65 MGD Marston Lake North Side Filter Plant. The plant personnel is "well pleased" with the Chlorinizer, according to Denver's Water Board Sanitary Engineer George J. Turre.

The Marston Lake Plant supplies a network stretching to points as far as five miles away. This necessitates heavy chlorine dosages in order to hold safe residuals throughout the system. Chlorinizer, with its wide metering range, has met every demand placed upon it. Dosage adjustments have proved easy to make due to Chlorinizer's responsive chlorine control valve. The direct-reading Chlorine Sightflo Indicator has also provided a positive means of checking the feed rate.

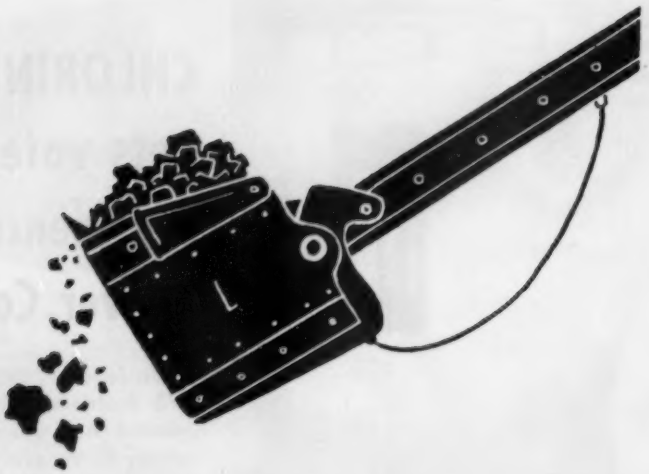
More and more progressive municipalities like Denver are turning to Chlorinizer — for new projects, for replacement, for plant expansion. May we quote on your requirements? Send details or write for descriptive bulletins to Builders-Providence, Inc., 365 Harris Ave., Providence 1, R. I.

BUILDERS-PROVIDENCE

DIVISION OF B-I-F INDUSTRIES, INC.

BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • OMEGA MACHINE CO.

BIF METERS FEEDERS CONTROLS



for tomorrow's expansion *Call in National today!*

You can meet tomorrow's increased water demands with *clean water mains.* National is prepared to prove to you *how cleaning can effectively uprate your water system.*

Resultant higher pressures, increased volume and reduced pumping costs will prove that National Cleaning is an investment—not an expense.

Why not do as other leading cities have done—let *National* cleaning provide for tomorrow's expansion without capital expenditure today!

Remember, there's no obligation or cost for a thorough inspection by National engineers. Write us today!

Call in National today!

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American Roll-On Joint Pipe

AMERICAN Roll-On Joint pipe is growing rapidly in popularity. This type of pipe is offered as an alternate for standard bell and spigot pipe, and has gained wide acceptance within a comparatively short period of sixteen years. Roll-On Joint is included in new Federal Specification WW-P-00421 as Joint Type II. Users of this type of cast iron pipe are enthusiastic about it.

Roll-On Joint pipe, in sizes 2″ through 48″, is cast centrifugally by the Mono-Cast process. Standard joint materials, including rubber ring, jute and bituminous joint compound are furnished with the pipe. The Roll-On Joint, a positive rubber-packed bottle-tight joint, is lower in cost than other types of joints.

The above illustration shows 48″ Roll-On Joint pipe being used in the construction of a 7-mile-long water supply line in Texas. Depending upon local conditions, the contractor laid from 500 feet up to 1,000 feet per day. The final tests on the line showed the Roll-On Joints to be bottle-tight.

AMERICAN

1905 - GOLDEN ANNIVERSARY - 1955

AMERICAN CAST IRON PIPE CO. 50 YEARS BIRMINGHAM, ALABAMA

Water is vital... and for fifty years BADGER meters have conserved the nation's water BETTER

Fire fighting

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L food . . . industrial production — all these depend on the availability of water. For 50 years, since 1905, famous Badger meters have helped Americans conserve water better. They measure water precisely . . . help control water distribution and waste . . . make water departments more efficient and self-supporting. And service records prove the dependability of Badger meters . . . prove there are no finer water meters made.

Badger Water Meters

"Measuring the water of the world for 50 years"

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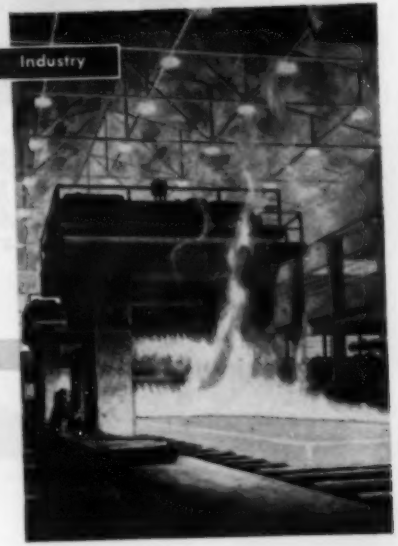
Seven Badger Meter Plants: Milwaukee, Wis. • Brown Deer, Wis. • Fall River, Wis. • Milwaukee, Wis. (Research) • Los Angeles, Calif. • Tulsa, Okla. • Medidores Azteca, Mexico, D. F.

Industry



From Moose Jaw to Tuscaloosa

At Moose Jaw, Saskatchewan, they used 65,000 feet of Armco Welded Pipe.

At Tuscaloosa, Alabama, they installed 27,000 feet of Armco Welded Pipe.

Armco Pipe Meets Water Line Requirements

From Saskatchewan to Alabama, cities are finding that Armco Welded Steel Pipe meets their needs in water supply and force mains.

WIDE SIZE RANGE

Standard sizes include diameters from 6 to 36 inches; wall thicknesses from 9/64- to ½-inch; lengths up to 50 feet.

EASY INSTALLATION

With the extra-long 50-foot lengths of Armco Pipe there are fewer sections to handle, and fewer joints to be made. Work goes faster. Labor costs are low.

STRONG, DURABLE

Armco Welded Steel Pipe has a high strength/weight ratio coupled with flexibility that withstands internal or external pressures. A smooth, spun-enamel lining prevents tuberculation and assures continued high flow capacity. Armco Drainage & Metal Products, Inc., Welded Pipe Sales Division, 4575 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada, write Guelph, Ontario.

ARMCO WELDED STEEL PIPE

Meets A. W. W. A. Specifications

ARMCO®

Atlanta engineers, Wiedeman and Singleton, *again specify*

INERTOL® PAINTS

Pump room and part of main operating floor—Water Works, Griffin, Georgia

Economical protection from abrasion, submersion, condensation and humidity is achieved here with colorful, durable Inertol coatings: Glamortex® takes hard knocks; Torex® is *made* for submersion; Ramuc® Utility withstands condensation and an average 75% humidity during the winter.

● Noted for the production of turkish towels, velvets and paper boxes, Griffin, Georgia, also claims one of the best-kept water works in the South. Wiedeman and Singleton are the consulting engineers on the job, and they have been specifying Inertol coatings ever since 1939. They know Inertol coatings are versatile and resistant... each coating meeting rigid specifications of hardness, elasticity and chemical inertness as well as providing lasting beauty.

Every water works coating you select from the Inertol line has been developed for a particular purpose. Each has had its superiority proved in hundreds of installations throughout the country. Our Field Technicians will welcome the opportunity to discuss the Inertol line fully with you at your office. Or write today for the "Painting Guide"—an invaluable aid for Design Engineers, Specification Writers and Plant Superintendents.

Inquire about Rustarmor®, Inertol's new hygroscopically-controlled rust neutralizing paint.

INERTOL CO., INC.

Inertol

INERTOL PROTECTION MEANS LOWER MAINTENANCE COSTS

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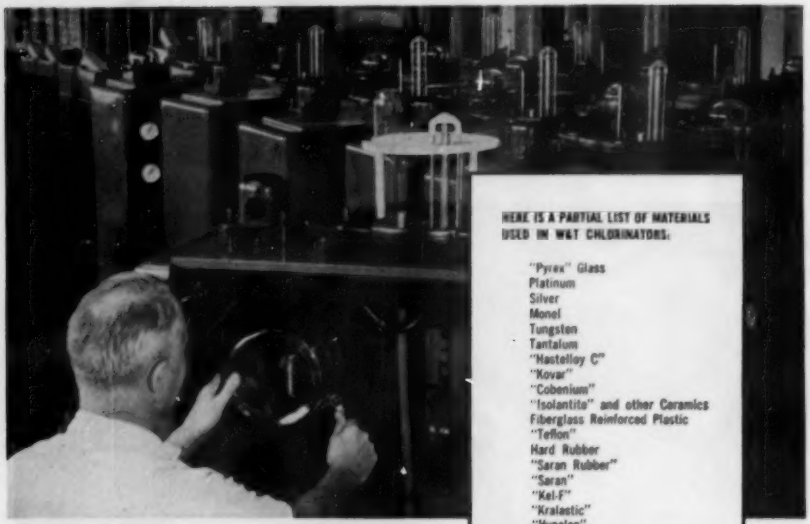

Where glass is needed, glass is used . . .

How well chlorination equipment does its job depends not only on proper design but on the selection of the right material for each part of the assembly.

In W&T equipment, every part is employed where it best suits the purpose for which it is intended. And every part gives good service because it is made of the right material for the job. Glass, metals, ceramics, and many types of plastics are used throughout Wallace & Tiernan's complete line of chlorinators — and each is selected for its ability to give you the most satisfactory operation under your plant conditions.

Since 1913, W&T research has consistently sought out new designs, principles and materials. Every new development is placed under rigid field tests to prove it can meet the exacting standards that dependable and economical chlorination demands.

When you depend on W&T equipment, you have the assurance that 40 years of experience in the chlorination field is being used to bring you the best in design, parts, and materials — selected and tested specifically to fit the need.

S-94

"Make Your First Choice Equipment That Lasts"

WALLACE & TIERNAN INCORPORATED
25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

Journal
AMERICAN WATER WORKS ASSOCIATION
VOL. 47 • MARCH 1955 • NO. 3

Variations in Construction Costs

Thomas M. Niles

A paper presented on Nov. 4, 1954, at the Virginia Section Meeting, Richmond, Va., by Thomas M. Niles, Partner, Greeley & Hansen, Engrs., Chicago.

FOR several months preceding the date of writing (November 1954) contract construction costs went down while wage rates and material prices went up. Engineers, who for years have had trouble keeping their estimates high enough to stay abreast of rising costs, were suddenly faced with construction bids far below expectation. On six recent projects, the low bids ranged from 73 to 90 per cent of the estimates and averaged 78 per cent.

Many engineers have used the *Engineering News-Record* "Construction Cost Index" (EN-R index) as the principal basis for adjusting past cost records to present or future cost estimates. It is now realized that more attention should, perhaps, have been paid to influences other than wage rates and material prices. This paper presents the results of attempts to: [1] determine what factors have been responsible for the wide fluctuations in actual costs, both above and below the EN-R index levels, and how such factors may be taken into account effectively in estimating future projects; and [2] project the cost index figures into the future.

In the work of the sanitary engineer, two kinds of estimates are prepared and used at different stages of a project. The first, which accompanies the preliminary investigation and report, is usually based on such overall unit expenses as the cost per capita or per unit of capacity for different types of plants, the cost per unit of volume for different types of structures, or the overall price per foot for pipelines. Liberal contingency allowances are included, and the amount of the estimate is largely a reflection of the judgment of the engineer. This type of estimate is used as an indication of the feasibility

of a project, as a means of comparing the costs of alternative projects, and generally as a guide to procedure. Such estimates sometimes serve as the basis for a bond issue referendum.

The second kind of estimate, prepared following completion of the detailed construction plans and specifications, usually is made by applying the expected unit prices to the final quantities of work, materials, and equipment taken from the drawings. This type of estimate is used as a check on the actual bids (which, if considered unreasonably high, may be rejected); it is frequently used as the basis for financing; and it may be the basis for preliminary rate schedules and for presentations at public hearings. In view of the importance of the decisions and procedures based on the two types of estimates, it is essential that they both be as accurate as is reasonably possible.

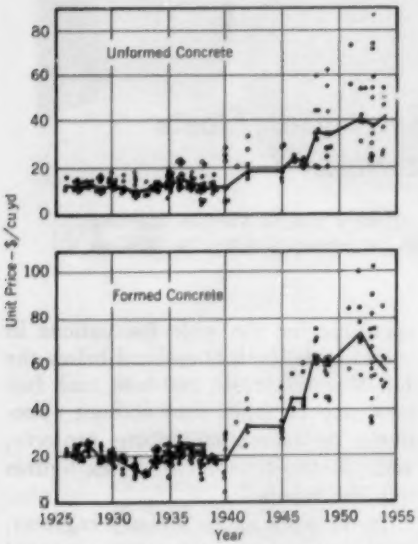

Fig. 1. Bid Prices for Concrete

Unformed concrete—floors, footings, etc.; formed concrete—walls, beams, slabs, etc.

Index and Bid Prices

In both preliminary and final estimates, the prices utilized are usually based on the lower range of bids on earlier jobs, with adjustments for differences in conditions. The EN-R index, perhaps because of its wide distribution and convenience of reference, has often been used in making price adjustments. Generally, its use has resulted in estimates that are reasonably close to the bids later received.

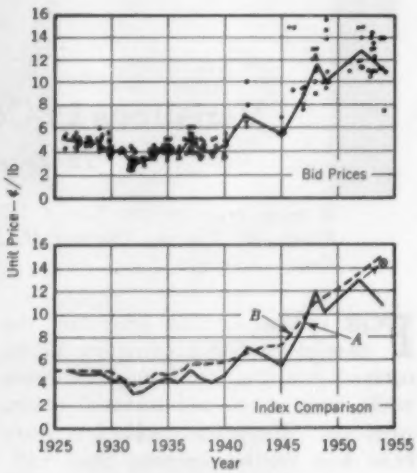

Fig. 2. Reinforcing Steel

A—*median of bid prices;* B—*prices calculated using EN-R index.*

This index is based solely on wage rates and material prices and does not take into account such factors as scarcity of labor, materials, and equipment, productivity of labor, and competitive conditions, all of which significantly affect the bids. Of other indexes

available, at least two give some, but apparently insufficient, recognition to these auxiliary factors. An index tailored to the estimating requirements of sanitary engineering projects would be a worth-while contribution to the profession.

In investigating the relationship between actual costs and those indicated by the EN-R index, the author's firm has tabulated and plotted prices bid for formed concrete, unformed concrete, and reinforcing steel on a considerable

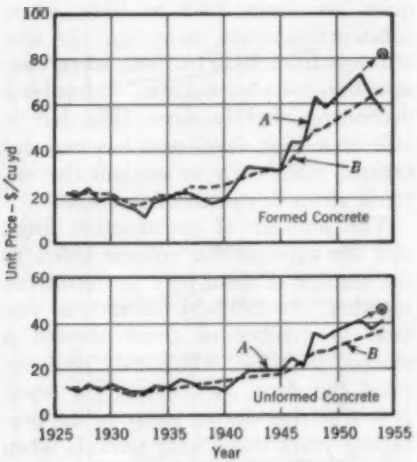

Fig. 3. Concrete Price Index Comparison

A—*median of bid prices;* B—*prices calculated using EN-R index.*

number of its own jobs from 1926 through October 1954. Figure 1 shows the bid prices for the two classes of concrete. The plotted points are the unit prices bid by the lowest, second lowest, and third lowest bidders for the entire job. Wide scattering of the plotted points is evident. The solid line through the plotted points connects the medians for each year. Figure 2 shows the bid prices for reinforcing steel and the relationship between the median of the prices bid and those calculated using the EN-R index, with the year 1926 as the point of reference. Generally, the reinforcing-steel costs have been below the calculated prices throughout the period.

Similarly, Fig. 3 shows the relation between the median of bid prices and the prices calculated from the EN-R

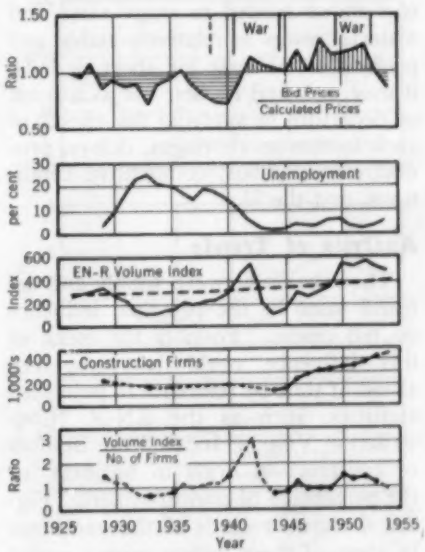

Fig. 4. Significant Trends

The ratio of construction volume to number of firms appears to be a most promising aid in estimating construction cost fluctuation.

index for both formed and unformed concrete. For formed concrete, actual costs were generally below the index levels from 1929 to 1941, which may be called the depression years, and above index levels from 1942 through 1954, which may be called the war years. The cost of formed concrete, which involves considerable labor for

form work, is probably more nearly comparable to overall construction costs than the cost of either unformed concrete or reinforcing steel.

It is unfortunate that, at best, cost indexes all represent hindsight: they indicate where prices have been, but not where they are going. Some advance indication of what the actual construction costs are likely to be would be very useful. As the basic cost index related to wage rates and material prices is relatively stable and predictable, at least for short periods, it may well find its best use as a point of departure in applying the effects of such factors as shortages, delays, productivity of labor, competitive conditions, and the like.

Analysis of Trends

The relation between supply and demand must be the principal influence on bid prices. Possibly the trend of this influence could be recognized ahead of time by reference to published statistics, such as the EN-R "Construction Volume Index," the number of construction firms in business, or the percentage of unemployment. Figure 4 shows records of the variations in some of these factors over a period of years. The upper diagram shows, for formed concrete, the ratio of bid prices to prices calculated on the basis of the EN-R cost index. The next three diagrams show percentage unemployment, construction volume, and number of construction firms in business. The lowest diagram shows the ratio of the volume index to the number of firms.

These general trends appear to have some significance, but are not entirely consistent. For instance, the percentage unemployment was high throughout the depression period, when bid prices were below EN-R cost index levels, and has been low throughout the period when bid prices have been above the index. In some years, however, the bid prices have been high when unemployment was increasing, while in other years they have decreased although unemployment decreased. The present level of unemployment is below that of 1949 and 1950, when construction costs were relatively high.

The volume index shows still greater inconsistencies, having been quite low from 1945 to 1949, when construction costs were up. It was also low from 1930 to 1940, when construction costs were down. It has been decreasing slightly since 1952 but is still at a high level and has not decreased sufficiently to explain the extreme drop in construction costs.

The number of construction firms and the ratio of the volume index to the number of firms may be considered together. In 1953–54 the ratio of volume to number of firms showed a marked decrease, which may well explain the drop in construction costs. It is true that during many of the preceding years there were periods when the costs increased or decreased sharply without corresponding changes in the volume ratio, but, in such instances, major economic upheavals may have been of overshadowing significance. Of the several factors and statistical indicators scrutinized, the ratio of volume of work to number of construction firms appears to be the most promising as an aid to estimating construction cost fluctuation.

One important indication, which, unfortunately, becomes evident too late to be of much use, is the number of bidders interested in a particular project. On recent projects involving the

author's firm, a record number of contractors have requested plans and specifications, and the bids have been substantially below the estimates.

There is a possibility that the present situation is normal rather than abnormal and that the country has reached, or is about to reach, the end of an abnormal "war economy" period. The high costs experienced since 1941 are explainable by the two wars and the greatly accelerated production of peacetime commodities in extremely

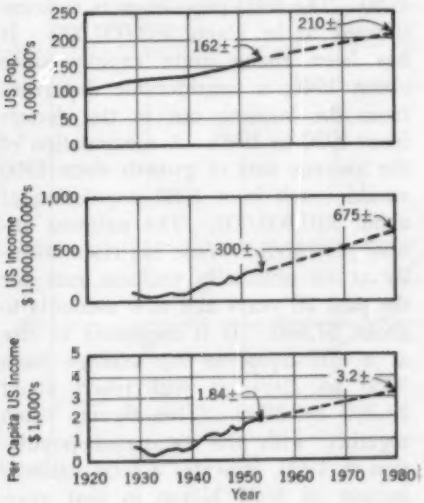

Fig. 5. Population and Income

These projections assume no major war or economic upheaval.

short periods of time. It seems more likely, however, that the present bids may be generally too low to cover costs, overhead, and reasonable profit, and, thus, will not continue at low levels beyond a short period. On this assumption, future prices may be expected to be somewhat higher in relation to the cost index than they are now, although probably not as high as in the past few years.

For more than 20 years, the EN-R cost index has risen consistently, and to date there has been no indication that wage rates or material costs, on which the index is based, are becoming stabilized or are likely to decrease. On the other hand, there is reason to be-

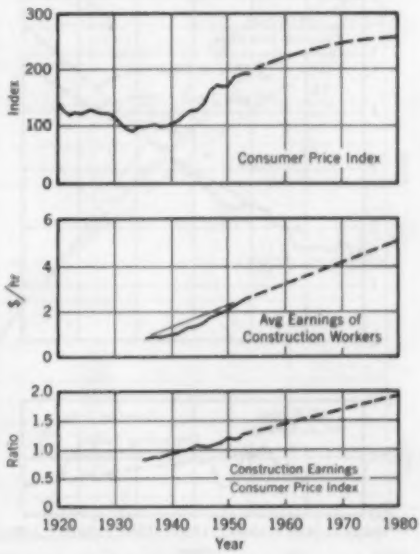

Fig. 6. Consumer Prices and Construction Worker Earnings

The relationship between these factors has been remarkably consistent since 1935.

lieve they will continue to increase in the future, although perhaps at a reduced rate.

Forecasts

As wage rates and material prices are closely related to the entire national economy, consideration of future construction cost levels should properly

take into account the likely overall trends. For instance, it may be expected that the national income will increase at a greater rate than the population or, in other words, that the national income per capita will continue to rise; that high military expenditures will continue; that low percentages of unemployment will continue; that the national budget will be balanced, one result being a continuing decrease in the ratio of the national debt to the national income, although the amount of the debt may remain about the same or decrease very slowly; that taxes will be reduced; that the national per capita income will increase at a slightly greater rate than the cost of living; that average earnings in the construction field will increase at a slightly greater rate than the national per capita income; and that the cost of living, in dollars, will continue to rise. All of the forecasts in connection with this study are based on the assumption that no large-scale war effort or other major economic upheaval will occur.

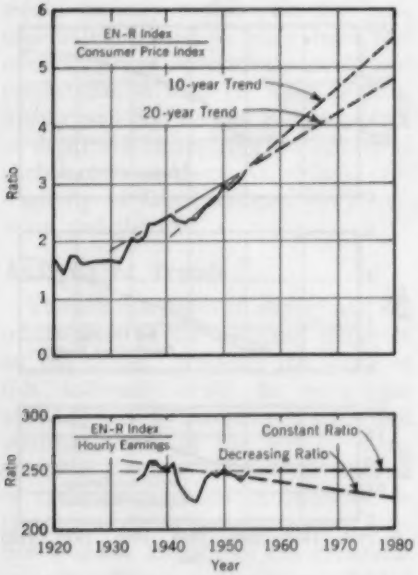

Fig. 7. Construction Costs, Consumer Prices, and Hourly Earnings

The EN-R index is for construction costs; hourly earnings are the average for construction workers.

Figure 5 shows the total population of the United States, the total national income, and the national income per capita, all three projected to the year 1980. The total population is now estimated to be about 162,000,000. It has been rising quite rapidly since about 1940, a considerable departure from the leveling out in the decade from 1930 to 1940. A continuation of the average rate of growth since 1900 would result in a 1980 population of about 210,000,000. The national annual per capita income has risen steadily at an unusually uniform rate for the past 20 years and now amounts to about $1,840. If it continues to rise at a rate equal to the average from 1930 to 1954, it will reach about $3,200 by 1980. This figure, taken together with the estimated population in 1980, indicates a total national income of $675 billion in that year, compared with about $300 billion in 1954.

Figure 6 shows records and forecasts of the consumer price index, which is a measure of the cost of living; the average hourly earnings of construction workers; and the ratio of construction earnings to the consumer price index. It is assumed that the consumer price index, now slightly under 200, will reach about 260 by the year 1980. The relationship between average hourly earnings of construction workers and the consumer

price index has been remarkably consistent (almost a straight line) since 1935. It is assumed that this straight-line relationship will continue to 1980. If so, and if the consumer price index increases as assumed, the average hourly earnings of construction workers will increase from about $2.50 at present to about $5.00 in 1980. This assumed future increase in hourly earnings is at about the same rate as that which has been in effect since 1935 and is substantially lower than the rate experienced since 1941.

In the past the EN-R construction cost index has risen at a more rapid rate than the general cost of living. This statement is illustrated in Fig. 7 (top), which shows the ratio of the EN-R index to the consumer price index. Two future trend lines are shown, the lower at the rate experienced for the past 20 years and the higher at the rate experienced for the past 10 years.

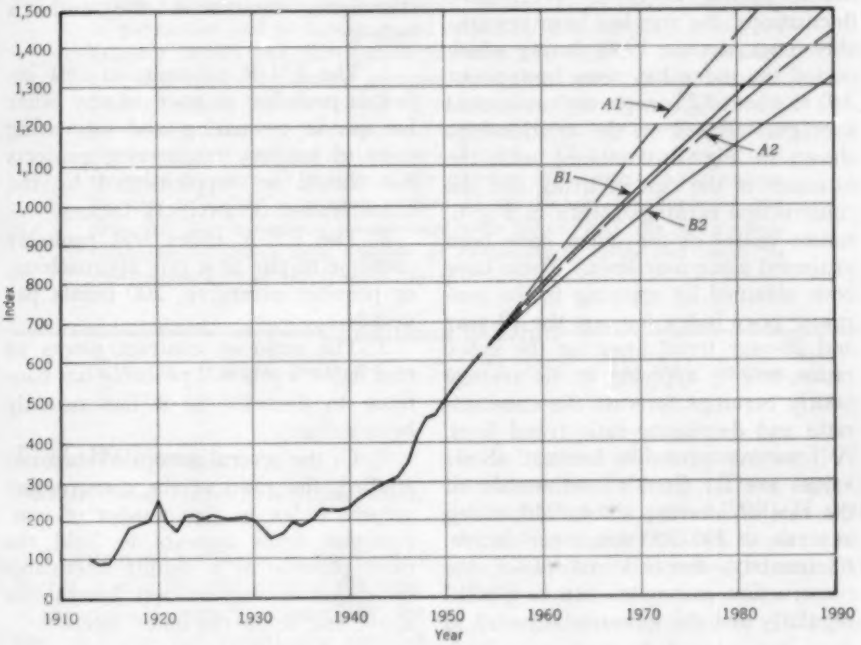

Fig. 8. Projections of EN-R Construction Cost Index

A—*based on ratio of construction cost index to consumer price index* (A1, *10-year trend, 1945–54;* A2, *20-year trend, 1935–54*); B—*based on ratio of construction cost index to average hourly earnings of construction workers* (B1, *constant ratio;* B2, *decreasing ratio*).

The bottom graph in Fig. 7 shows the ratio of the EN-R index to the average hourly earnings of construc-

tion workers. This ratio has apparently established a downward trend but may also be considered to have reached a constant level. Lines have been drawn to represent both the decreasing and the constant ratio.

Figure 8 shows the past record and forecast of the EN-R construction cost index, starting in 1913. With some fluctuations, the rise has been remarkably constant since 1940, during which period the index has risen from about 240 to about 625, expressed as annual averages. Based on the relationships shown in Fig. 7, combined with the forecasts of the cost of living and the construction earnings shown in Fig. 6, future values of the index have been projected along four lines. These have been obtained by applying to the consumer price index forecast the 10-year and 20-year trend lines for the index ratios, and by applying to the average hourly earnings forecast the constant-ratio and decreasing-ratio trend lines. A resulting probable forecast shows values not far from a continuation of the rate of increase since 1940, rising at a rate of 200–300 points per decade. Fortunately, monthly values of the construction cost index can be plotted regularly and the forecasts adjusted to meet changes in the trend as they become apparent.

Summary

It would be a mistake to apply the word "conclusions" to the results of the studies, assumptions, and opinions discussed in this paper. The following statements summarize the author's beliefs:

1. The EN-R construction cost index is probably as good as any other for use in comparing and estimating costs of sanitary engineering projects but should be supplemented by the consideration of auxiliary factors.

2. The EN-R index will probably continue to rise at a rate approaching, or possibly exceeding, 200 points per decade.

3. The ratio of contract prices to cost index levels will probably not continue to decrease as it has recently been doing.

4. Of the several groups of statistics studied, the ratio of the construction volume index to the number of construction firms appears to hold the most promise as a readily obtainable indication of contract cost fluctuations above and below the index levels.

Eastern Water Shortage and Drought Problems

A Symposium

In recent years problems of water shortages have plagued public supply systems in many parts of the United States. High rates of increase in population and in domestic and industrial demand have overtaxed existing supply and distribution facilities. In 1953–54 the situation was aggravated by severe drought throughout most of the country. This condition had the double effect of raising the demand (for such purposes as lawn sprinkling and farm land irrigation) and depleting the sources of supply formerly relied upon. This symposium is not intended to cover all aspects of the problem in all parts of the nation. Its aim is rather to give a picture of the impact of shortages and drought, the immediate countermeasures taken, and the long-range solutions advocated in a number of communities, large and small, in the eastern half of the United States.

Conditions in Ohio

A series of papers presented on Sep. 23, 1954, at the Ohio Section Meeting, Dayton, Ohio.

L. G. Williams

Partner, Jones, Henry & Williams, Cons. Engrs., Toledo, Ohio.

The demand for water in the United States is rapidly approaching the limit of the available supply. Since 1900 the use of water has practically doubled every 25 years; thus, it is estimated that by 1975 the demand will be twice that of 1950 and will require roughly 90 per cent of all the water that can be developed at reasonable cost under present conditions. The importance of taking steps now to insure adequate supplies in the future is self-evident.

In 1950 the total fresh water withdrawn from wells and surface supplies amounted to 170 bil gal per day, of which 18 per cent was supplied from wells and 82 per cent from streams and lakes. A breakdown of water use in 1950, together with estimates for 1975, is shown in Table 1. These figures indicate that the period 1950–75 will see a 50 per cent increase in domestic use, 230 per cent in industrial use, and 25 per cent in irrigation use.

It will be noted that by 1975 the industrial demand is expected to be almost nine times as great as the domestic and that industry shows by far the largest increase in water requirements. One of the reasons for this increase is the trend toward the manufacture of more types and greater volumes of synthetic products. Nylon and rayon, for example, require more water than does the processing of wool and cotton which are being replaced. Similarly, larger quantities are needed for the processing of synthetic rubber than for natural rubber.

The figures in Table 1 are for the entire country, but conditions of availability and use are far from uniform. In the West, except for the Pacific Northwest, the rainfall is generally less than in the East and is so distributed, both seasonally and geographically, that a much larger percentage of water is used for irrigation than in the East. In contrast, a larger percentage of water is used for industry in the East than in the West. Table 2 compares the 1950 estimated distribution of demand in the seventeen states lying west of a line from Minnesota to Louisiana with that in the 31 states east of this line. In the West, the large use is for irrigation and in the East for industry. In the East, five times as much water was used for industry in 1950 as for all other uses combined. According to Table 1, industrial use will expand 230 per cent by 1975.

TABLE 1

Present and Projected Water Demands

Type of Use	Water Demand			
	1950		1975	
	bgd	%	*bgd*	%
Domestic	17*	10	25	7
Industrial	65	38	215	62
Irrigation	88	52	110	31
Total	170	100	350	100

* Municipal, 80 per cent; rural, 20 per cent.

The projection of population growth in Ohio indicates that it will increase about 27 per cent by 1975, double in 65 years, and triple in 102–115 years. It is interesting to note that in the century from 1850 to 1950 the population of Ohio quadrupled, increasing from 1,980,329 to 7,946,627. To maintain and improve the standard of living, industrial production must expand to keep up with the growing population. The provision of a water supply adequate to meet this fast rising demand poses a serious problem.

The total rainfall in Ohio averages 38 in. per year. Of this amount, about 70 per cent returns to the atmosphere through evapotranspiration. The remaining 30 per cent replenishes the ground water supply or runs off into surface streams. The total water supply, whether obtained from wells or surface runoff, is limited by the net yield of rainfall. Seasonal variation and the possibility of longer cycles of wet and dry years must be considered in dealing with any water supply problem. The future may bring ways of increasing rainfall by artificial methods, but as yet there is insufficient evidence that any large-scale benefits can be obtained in this fashion.

TABLE 2

Distribution of Demand

Type of Use	Distribution—per cent	
	17 Western States	31 Eastern States
Domestic	5	16
Industrial	3	81
Irrigation	92	3
Total	100	100

Availability of water may become the dominant influence in future industrial expansion in Ohio. If there is insufficient water, industry may follow the already existing trend of moving to the South or the Pacific Northwest, where supplies are more abundant.

Planning for the Future

The problem, reduced to its simplest terms, is to increase the quantity of

water available or reduce the quantity required. In Ohio, a combination of both methods may be necessary.

Regulation of streams by construction of surface reservoirs is an effective method of preserving excess water for use in dry periods. This is, perhaps, the most readily available means of increasing the supply for the next several years. Reservoirs, however, will not increase the total yield but will actually reduce it by the amount of evaporation loss. This loss, which may reach about 30 in. per year, may be a substantial part of the total yield in shallow reservoirs. Reservoirs may be useful for many years, but they do not provide a permanent solution for the water supply problem. The accumulation of sediment in a reservoir will gradually reduce its capacity. The cost of removing sediment is normally prohibitive, but future generations may be forced to accept this cost, as the number of suitable reservoir sites is limited.

Efficient use of ground water storage, by itself or as a supplement to surface storage, has many advantages. Water can be held for indefinite periods with a minimum of evaporation loss. Temperature is kept relatively uniform through the seasons, an important consideration for both domestic and industrial use (nearly half the industrial water demand is for cooling). Ground water may be replenished by natural infiltration, by artificial flooding of pervious areas, or by providing recharge wells. Ground water is an important part of the total supply and should be used wisely. Continued pumping at a rate higher than the rate of replenishment will eventually dewater an aquifer and may permanently impair its usefulness. Such use of ground water only aggravates the problem of supply for the future.

Of the water withdrawn for municipal and industrial use, a large proportion, variously reported as from 60 to more than 90 per cent, is returned to the streams. Elimination of pollution from the returned water, thus permitting greater reuse, is one of the most effective methods available to insure adequate future supplies. This feature of the problem can be controlled by man.

To decrease water waste, industrial processes can be modified to provide for recirculation or reuse of water and for greater use of air cooling to supplement or replace water cooling in critical locations. These and similar measures will help to reduce the total water required.

In parts of Ohio, pumping of water from Lake Erie to supplement or replace present limited supplies within local watersheds may be the most practicable solution. Diversion of water to areas outside watersheds may also be entirely feasible and economically sound but may involve questions of interstate, as well as international, water policy. Provision of reservoirs for more nearly complete development of downstate water resources would seem a more logical first step in Ohio.

Many interests are affected by water policy. In addition to municipal and industrial supply, there are such other considerations as navigation, flood control, shore erosion, power generation, irrigation, waste disposal, fish and wildlife, and recreation.

Planning for the future calls for thorough knowledge and complete and reliable basic information. There is much to learn about the hydrologic cycle, infiltration of water into the earth, transpiration, and ground water discharge and recharge. Studies must be carried on to obtain the maximum amount of information on regional ge-

ology, extent and character of aquifers, materials suitable for construction of dams and reservoirs, and related items. Continuous, long-term gaging-station records are necessary for determining the volume of surface runoff. Data on these and other matters are essential to proper planning for the conservation and development of the water supplies on which the future growth and welfare of Ohio and the rest of the nation depend.

Acknowledgment

The author is indebted to various issues of ASCE proceedings and transactions, US Geological Survey papers, and the President's Materials Policy Commission report for 1952 for some of the data included in this paper.

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During the 1953 drought the yields of many public water supplies obtained from both ground and surface sources became inadequate. In general, the quantity of water available from wells in Ohio is rather limited, with the result that very few of the larger cities in the state depend upon such supplies; Canton and those municipalities located along the Miami and Tuscarawas-Muskingum rivers are exceptions. Owing to increasing demands, a large number of cities and villages that formerly depended upon wells are now using surface water for the entire municipal supply or as a supplementary source. A few of these towns changed from a well to a surface supply because of the objectionable mineral quality of the former; this factor, plus the inadequacy of the well water supply, was also a major influence in the change to surface water at a considerable number of other localities. By contrast, only one city, Marietta, and two villages, New Richmond and New Matamoras, which formerly used surface water supplies have changed to wells. These three municipalities are all located along the Ohio River, and the change was made to avoid the need for treating the river water.

To keep this discussion within reasonable limits, only the cities will be considered. In general, the villages face the same problems as the larger communities, but to a lesser degree.

Eight of the ten largest cities in Ohio, and sixteen of the twenty cities with more than 35,000 population, obtain their public water supplies from surface sources. The 140 largest communities in the state have a total population of approximately 4,500,000. Of these cities, 93, with a total population of 4,086,000, obtain their supplies from surface sources; Lake Erie is the source for 30 cities (total population 1,794,000); 14 (total population 686,000) obtain their supplies from the Ohio River; the remaining 49 cities (total population 1,606,000) depend on inland streams or lakes. Most of those 49 cities have water supply problems.

It is safe to state that the population and industrial growth of the inland cities in Ohio will be limited by the size of the water supplies that can be developed to serve them. Several of the inland cities have already developed the surface supplies in their vicinity almost to the limit. In most instances, however, surface supplies sufficient for many years are available for development within a reasonable distance of the cities and at a reasonable cost.

There is enough rainfall in Ohio, even during drought years, to furnish adequate water supplies for the inland

cities of the state over a long period, if ample storage facilities are provided. Only in the distant future, when local resources are exhausted, will it, perhaps, be necessary for the inland cities to draw upon Lake Erie and the Ohio River.

In the past most Ohioans regarded an adequate water supply as a matter of course, and most persons outside the water works field still think that sufficient water can be obtained locally at low cost. Unlike the cities in the West, where water is at a premium, Ohio communities have not yet had to go long distances to obtain water supplies, nor have they been willing to pay the high costs that result when water must be transported from afar.

Only fourteen of the 49 inland cities obtain water from streams on which no storage is provided. As a sustained stream flow adequate for future needs is available without storage at only six of these fourteen cities, storage facilities will eventually have to be installed by the other eight. Of the 35 inland cities with storage, some have facilities that will be adequate for a considerable period in the future. A larger number of them must soon enlarge their storage facilities to meet increasing water demands or even present demands during a dry year. The 1953 drought gave an impetus to the installation of additional storage facilities; construction is or shortly will be under way at six cities.

An adequate income during prosperous years is no protection against hard times unless some of the income is conserved. Similarly, abundant rainfall and adequate stream flows during normal years are no protection against water shortages in dry years unless adequate storage facilities are provided. The necessity for municipal officials and engineers to recognize the importance of planning and installing adequate surface storage facilities cannot be overemphasized.

Paul Kaser

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The maintenance of a ground water supply in quantities sufficient to keep pace with increasing population and growing industrial development is basically a problem of efficient management of the resources that nature has provided.

The nature of the strata underlying the surface and the manner in which they were formed determine the presence or absence of ground water reservoirs in any given locality. Climate, principally the amount and distribution of rainfall, determines the amount of water stored in these reservoirs from season to season and from year to year. The climate of Ohio is such that its ground water reservoirs receive relatively large amounts of recharge annually (the years 1953–54 have been exceptional). For this reason, ground water users in Ohio can balance withdrawal and replenishment, and thus avoid continuing depletion of the supply. It is not intended to imply that ground water levels should not be depressed below their natural stages. Gradients must be established by lowering water levels around a pumping well in order that water can flow to the well; otherwise pumping could not be continued. Thus, there are benefits to be derived from a reasonable lowering of the ground water level.

Ground water moves continuously from the location at which it enters the reservoir to some point where it is discharged into a surface stream.

Pumping, therefore, salvages some of this water, which would otherwise be wasted as far as the ground water reservoir is concerned. Ground water reservoirs have a maximum capacity, just as surface water reservoirs do. Recharge may be rejected by an aquifer that is full. In such situations, lowering the water level by pumping may increase the amount of replenishment during the recharge period.

The methods and tools for locating and evaluating a ground water source have improved immensely in the past decade. The thousands of well logs on file with state divisions of water enable the geologist to say with certainty whether or not there is a water-bearing formation underlying any given area. Improved and established formulas enable the hydrologist to determine with certainty the yield to be expected from a water-bearing formation. Test drilling, pumping tests, and systematic water level measurements are valuable tools in the hands of these specialists.

Decreased Well Yield

Wells that decrease in production are one of the most vexing problems encountered. One cause of this trouble may be an excessive lowering of water levels in the immediate vicinity of the pumping installation. If systematic water level measurements have been recorded in the well field, warning will be given in time to take remedial measures before a serious situation can develop. It may be possible to spread, and thereby lessen, the effects of pumping by drilling new wells in a more distant part of the aquifer, or another aquifer above or below the one in use may be tapped for additional supply. If the demand exceeds the safe yield of the aquifer, part of the water supply may be obtainable from surface sources. Pumping tests properly conducted and analyzed, together with water level records, will give information on drawdown, interference between wells, and safe yield, pointing the way to a solution of this problem.

Perhaps an even more vexing cause of failing well production is incrustation. Chemicals such as calcium carbonate and iron are often found in ground water. The lowering of pressure at a pumping well causes these chemicals to precipitate and deposit on the well screen in gravel wells or in the cracks and pore spaces at the well face of a rock well. Not only do these precipitates form an incrustant themselves, but they also act as a cement that binds other compounds, like silica, to form an incrustant which further clogs screens and rock pores. Both conditions contribute to frictional loss at the well and result in decreased yield. Fine sand and clay particles carried in by water flowing to the well produce clogging of the formation near the well, with the same results. Sometimes decreased yield due to well clogging is mistakenly blamed on lowered water levels. A water level recorder in the well field will tell at once whether the trouble is general in the field or is in the well itself.

When clogging occurs, various methods of cleaning and redevelopment can be employed, but it is better to prevent the condition from arising. The principal cause of incrustation is the reduction of pressure in the ground water at the well. This, in turn, is inversely related to the velocity of the water entering the well. A lowering of velocity, therefore, tends to reduce clogging. In the design of a gravel well, it is important that the size of the screen slots be as large as possible, to provide the maximum total area of screen opening.

The larger the slot size, the longer it takes to clog the screen; and the greater the total open area, the lower the entrance velocity and, hence, the smaller the frictional loss in hydraulic head at the well and the less the incrustation. Proper well development at the time of drilling, together with gravel packing, if necessary, serves the same purpose.

The water level in the well should not be drawn down so that the screen or water-bearing rock is exposed to air, as exposure tends to increase the rate of incrustation. A water level recorder will warn the operator when such a condition threatens, so that he will often be able to make a pumping change to avoid it.

Enlargement of Supply

The problem of keeping pace with growing demands is probably the most common one faced by the managers of utilities with ground water supplies. The solution involves much the same considerations as does the selection of the original well site. Because ground water reservoirs have a limited yield, it is necessary first to determine what the safe yield is for a given aquifer and how nearly the limit is being approached. If the aquifer is capable of further development, the next problem is well spacing. If a new well is drilled within the cone of influence of an existing well, interference between the two will greatly reduce the productivity of both. These and other problems can be solved by an analysis of the performance of the aquifer. Pumping test data and water level records analyzed by modern methods take the guesswork out of the management of a ground water supply.

If current pumpage equals or exceeds the capacity of an aquifer a geologist may aid in locating additional supplies in other formations. State geologists and hydrologists, the US Geological Survey, and private consulting firms stand ready to apply improved knowledge to local problems, but they must have the essential data. Records of pumping and ground water levels, if systematically kept, will save much time and money and will help greatly in finding the solution to a given problem. The Ohio Div. of Water is now conducting a campaign to have the water level in every municipal well field in the state measured and observed by means of an automatic recorder. The division is in a position to give considerable help and cooperation to individual water departments in getting started on a program of systematic, accurate ground water level observation.

J. R. Patterson

Chief Engr., Floyd G. Browne & Assocs., Marion, Ohio.

Many Ohio municipalities have been suffering from a shortage of water supply during the relatively dry weather cycle occurring over the past few years. This discussion will deal with the experiences of two of them, the villages of Attica and Ashley, which found it necessary to haul supplementary water by tank truck during the summer of 1953. Attica depends on a surface supply and Ashley on wells.

Attica

Attica, located in Seneca County, had a 1950 census population of 858. The village water plant also serves the community of Caroline to the south and the unincorporated area of Siam to the north through a long 6-in. feeder main. The source of supply is the 71-sq mile watershed of Honey Creek

above a low dam at the plant. Except for short periods of extreme drought, the supply is reliable, partly because some ground water from springs drains into the stream system. The surface supply is used because, in this general area, it has been found unwise to rely on wells for quantities sufficient to meet municipal needs, and it has not been considered necessary to develop an auxiliary well supply.

As previously mentioned, during the summer of 1953 the Attica water plant had to be supplied by means of tank truck for approximately 21 days. This situation was caused by extremely low stream flow and the lack of storage to carry the plant through a critical period. The top of the Honey Creek dam extends only approximately 3 ft above normal water level. Over the years the pool above the dam was permitted to silt up, and, consequently, the storage volume in the pool was depleted to such an extent that the plant had to rely on practically instantaneous flows at a volume large enough to supply the demand. Obviously, when these flows became less than the demand, a critical shortage of treated water resulted.

A study of precipitation and flow duration data, obtained from the Ohio Dept. of Natural Resources, indicated that there is sufficient flow in Honey Creek to supply the water plant nearly 90 per cent of the time without the use of storage. From these data and a study of future requirements, it was determined that raw-water storage sufficient to supply the needs of the system for a period of approximately 40 days was the minimum necessary. It was decided to provide a new storage reservoir with a 60-day capacity, with enough additional capacity to offset losses due to evaporation and seepage.

The topography of the watershed immediately above the dam is such that raising its height to provide the needed storage is impractical economically. A very large land area would be flooded, and a shallow depth in such a pool would make it difficult to control algal tastes and odors. These considerations resulted in a decision to construct an aboveground reservoir, with a 10-ft water depth, immediately adjacent to the water plant on a tract of land less than 10 acres in area. The reservoir was designed with compacted-earth embankment, after analyses had indicated the soil to be suitable for this purpose. The total volume of water to be stored in the proposed reservoir is 16 mil gal, which, it is estimated, will supply the village for 60 days, with augmentation from the stream and allowance for evaporation and seepage losses. It was impossible to locate the reservoir on ground high enough to feed into the plant by gravity.

The problem at Attica involves not only the provision of raw-water storage but also the complete rehabilitation of the present water plant, an increase in plant capacity, and the installation of additional elevated storage for the distribution system. The existing treatment plant, built in 1915, was designed for coagulation, filtration, and disinfection. The quality of the water is such that softening is not necessary. From a small intake immediately above the dam, the water is pumped into existing settling tanks where coagulant is added. The water then passes through two 6×9-ft rapid sand filters and is stored in a 20,000-gal clear well, where chlorine is added for disinfection. The filter capacity of the present plant is

approximately 225 gpm. From the clear well, the water is pumped into the distribution system at a rate of about 250 gpm. The plant currently operates 10 hr a day, on the average. There is no main plant meter, although distribution is completely metered.

The plant has no chemical mixing, flocculating, or sludge removal equipment. The settling tanks are drained and cleaned manually, when necessary. The hypochlorite chemical feeder is inadequate for taste and odor control, and there is no carbon-feeding equipment. The filters are backwashed from the high-service line with the high-service pump running, an arrangement which does not supply sufficient wash water. As may be expected with a shallow reservoir, tastes and odors constitute a problem and frequently are present in the treated water.

Since 1915, unfortunately, the structures and equipment (including an 80,000-gal elevated tank) have been allowed to deteriorate to such an extent that it is now necessary to rehabilitate all of the existing facilities as well as to add new ones. This situation resulted from the desire of the village to curtail all possible maintenance expenses in order to keep the water rates at a minimum. As a consequence, it is now necessary to spend a comparatively large amount of money in order to place the plant in proper operating condition, as well as to increase its capacity.

The proposed additions to the plant will consist of a flocculation tank, a settling tank with a sludge removal mechanism, a third filter (for which space is available in the original building), and a new chemical-feeder building. The existing filter piping and the low-lift raw-water and high-service pumps will be replaced, and a plant meter will be installed. A new intake, with two new raw-water pumps of 500-gpm capacity each, will be constructed to supply water to the reservoir and treatment plant through a common pipe system. Two new low-lift pumps will deliver water from the reservoir to the plant. New chemical feeders for alum, activated carbon, and chlorine will be furnished. A new 150,000-gal elevated storage tank will be built. The plant additions are designed to serve 1,100 customers. It is estimated that the enlarged and rehabilitated plant will be able to supply the water demand, at a rate of 325 gpm, for the next 25 years.

The present water rate schedule provides for a minimum bill of $18 per year. This will be increased to $34 in order to furnish the necessary funds for financing construction by means of mortgage revenue bonds paying slightly more than 4 per cent. The total estimated construction cost for the complete project is $150,000.

Ashley

The village of Ashley, in Delaware County, obtains its water supply from three shallow wells approximately 25 ft deep. On account of the limited storage capacity of the aquifer and the reduced recharge in dry weather, these wells cannot meet the demand during extended periods without rainfall. Recently a new well was drilled to a depth of 220 ft. The only water located was in shale below 180 ft, and this contained such large amounts of sulfur and salt that treatment was not economical. In October 1953 the well supply was entirely exhausted, and for

3 months the village had to be supplied by tank trucks bringing water from the Delaware Reservoir on the Olentangy River, about 6 miles west of Ashley.

The 1950 census population was 798; the population used for design purpose was 900. There are 296 service connections, of which 80 are unmetered. Approximately one-third of the 216 metered services are not being read because the meters are not in operating condition; thus, there is a total of only 141 readable meters at the present time. The existing treatment plant is of adequate capacity. The water, which contains considerable hardness, undergoes lime–soda ash softening, filtration, and disinfection.

The principal problem at Ashley was the development of a surface supply with adequate raw-water storage. It was decided to use the nearby West Branch of Alum Creek as the source of the surface supply. Under extreme drought conditions there is practically no flow in the stream for as long as 2 months at a time. Taking this fact and future water needs into consideration, it was determined that a 15-mil gal storage reservoir would be sufficient to carry the village over a period of 3 months of extreme drought, allowing for evaporation and seepage losses. The topography of the area ruled out gravity flow from the reservoir to the plant. The site was immediately east of the existing water treatment plant and south of the West Branch of Alum Creek.

The new raw-water facilities included an intake at the creek, a storage reservoir, and a 100-gpm booster pump to deliver water from the reservoir into the treatment plant. A depressed type of intake, containing two submerged 100-gpm raw-water pumps, was built. The intake was deep enough to permit water to be pumped from the creek without an impounding dam. This type of intake eliminated the need for building an extensive superstructure to place the motors above high water and to prevent freezing.

The reservoir was located in ground containing a good, impervious clay, which was utilized to construct the earth embankment. One of the existing wells was connected to the pipeline from the intake to the reservoir to serve as a standby source in emergencies. The land area required for the reservoir was approximately 8½ acres.

The work was started in May 1954 and completed in August, at a total cost of approximately $23,200. Ashley was more fortunate than Attica, in that the former's treatment plant needed no additional facilities or rehabilitation. The construction was financed by means of mortgage revenue bonds bearing an interest rate of slightly more than 4 per cent. The bond issue was made large enough to cover the cost of a number of water main extensions and sufficient new meters to provide a completely metered distribution system. To pay the costs, the annual minimum water bill had to be raised from $26 to $32.

Conditions in West Virginia

A panel discussion presented on Nov. 8, 1954, at the West Virginia Section Meeting, Huntington, W.Va.

John B. Douglass

Chief Design & Constr. Engr., West Virginia Water Service Co., Charleston, W.Va.

The Charleston, W.Va., water plant serves the city of Charleston, South Charleston, their suburbs, and the adjacent rural areas, which in 1953 had an estimated total population of 116,000, with an estimated 29,000 water customers. The average 1953 pumpage for this area was 14.5 mgd, with a summer peak load of 19.4 mgd recorded on Sep. 3. The principal source of supply is the Elk River, which has a watershed of 1,500 sq miles above the intake. The Coonskin intake on the Elk River is located 4½ miles upstream from its junction with the Kanawha River and above the backwater of the Kanawha. The Slack Street intake station, located on the Elk ¾ miles above the junction, is in the Kanawha backwater pool. The Slack Street intake provides the difference between the raw-water demand and the 10,000-gpm capacity of the Coonskin intake pumps. The average 1953 daily flow of the Elk River was recorded at 1 bil gal, with a minimum daily flow of 220,000 gal on Nov. 3–5.

Charleston's water supply problem during drought periods is not one of quantity but of quality. It seems safe to say that the Kanawha River will always produce the water required to serve Charleston, if it can be treated to make it potable. It was water from the Kanawha that carried the city through the 1953 drought, and the details of how the pumping and treatment facilities were coordinated to make the water acceptable will be described.

During previous Elk River flow shortages a temporary sand, gravel, and boulder dam, approximately 4 ft high, had been built across the Elk River on the Coonskin Shoals to maintain a sufficient depth of water at the intake and prevent vortex swirls over the suction pipe. To regulate the pool height behind the dam and keep the pool from topping it, with resultant washout, five sluiceway pipes, 18 in. in diameter, were installed through the bottom of the dam with stop log slots welded to the downstream ends. A short section of the dam was made 6 in. lower to serve as a controlled point of washout if the pool should overflow the dam.

In the latter part of October 1952, when it became apparent that an increased amount of Kanawha River water would have to be used, it was decided to employ aeration to improve its quality. A certain amount of natural improvement could also be counted on, because it would take an estimated 20 days for the Kanawha River water to displace the water stored in the Elk Channel and reach the aerator. The problem was to pump Kanawha backwater and spray it into the pool behind the temporary dam, where existing permanent pumping facilities could deliver it to the filtration plant. Plans called for the installation of an emergency intake, a pipeline, and an aerator.

Sheds were built to house the pump and switchgear; 2,250 ft of 16-in.

buried cast-iron pipe was installed; and 490 ft of 16-in. aerator piping was laid above ground, with 81 2-in. nozzles set at a 45-deg angle to spray into the pool above the dam. The size of the equipment generally depended on what was available or could be delivered quickly. It was assumed that the flow in the Elk River would not drop below 4,000 gpm, so that 6,000 gpm was the anticipated maximum requirement from the Kanawha pool. A 6,000-gpm, 14×16-in. pump with a 250-hp motor was on hand. The 20 psi it would produce at the base of the nozzles was considered an efficient spray pressure.

Drought Diary

By the time these facilities were completed, the flow in the Elk had improved to such an extent that only a trial aeration run was made. The motor was removed to prevent damage from high water in the winter, and the equipment was stored for future use. All of the effort and expense seemed to have been wasted, but the installation proved its value during the next year's drought, as the following excerpts from the author's 1953 diary will show:

Aug. 27. Installed temporary sand and gravel dam to keep water up on intake.

Fig. 1. Elk River

This photograph of the Elk River below Coonskin Dam, looking downstream, was taken on Nov. 5, 1953, during a period of reverse flow.

Aug. 28. Installed floating leaf boom; 1 × 2-in. mesh fence submerged to prevent clogging of intake bar screens. River flow 36 mgd; pool 12 in. below intake.

Aug. 29–Sep. 1. Adjusted sluiceway stop logs to keep pool up and prevent it from topping dam. Notified lockmaster that emergency intake in Kanawha pool will be started, and requested that pool not be permitted to drop more than 2 in. Installed 250-hp motor on emergency intake pump removed last winter. Demothballed switchgear, priming line, and aerator nozzles. Consumption 18.9 mgd.

Sep. 2. Aerator pump started with 54 nozzles at 4,850 gpm. Newspaper and radio announcement made, requesting public to conserve water. Consumption 19.2 mgd. Temperature 103°F.

Sep. 3. Aerator filled pool behind dam and was shut off at 10:45 PM; 4-day supply without present flow of Elk, at 10,000 gpm. Consumption 19.4 mgd. Temperature 102°F. No benefit from newspaper announcement apparent. No Morgantown water conference for me.

Sep. 4. Temperature 103°F. Rain at night. Consumption 19.0 mgd.

Sep. 5. Water 1 in. over intake; took some stop logs out. Temperature 98°F. Consumption 17.9 mgd; reduction in consumption seems to be result of temperature drop and not of newspaper conservation request.

Sep. 6. Pool 10 in. below intake; put in some boards. Temperature 83°F. Consumption 14.3 mgd.

Sep. 7. Pool 5 in. below intake. Temperature 81°F. Consumption 14.5 mgd.

Sep. 8. Temperature 78°F. Consumption 16.5 mgd. River flow 19,200 gpm. Pool 3 in. below intake; put more boards in.

Sep. 9. Pool 1 in. over intake; took some boards out.

Sep. 10. Pool 8 in. over intake; took all boards out.

Sep. 25. River flow dropped to 7,600 gpm.

Sep. 28. River flow 6,750 gpm. Pool 4¼ in. below intake. Aerator losing ground; decided that more water will have to come from Kanawha pool, this to be obtained by replacing 250-hp motor by 500-hp motor with higher speed.

Sep. 30. Machine shop working on coupling and base adapter for 500-hp motor. River flow 5,800 gpm; 250-hp pump averaging 5,000 gpm.

Oct. 1. Aerator shut down 8:40 AM to remove 250-hp motor and install 500-hp; permission obtained from power company to start motor in daytime; new motor in service 3:15 PM. Pool 15 in. below intake at end of shutdown period.

Oct. 2. Pool 9¼ in. below intake. Bulldozed Mink Shoals to permit that pool to drain into Coonskin pool. Cut channel 6 in. deep to sheet rock from dam to Kanawha backwater pool, to provide suction water for gasoline pumps to be installed on dam.

Oct. 4. Pool 8¼ in. below intake; aerator pump output dropping; took head off and cleaned it; also cleaned nozzles.

Oct. 5. Cut Crede Shoals to drain water from that pool. Installed gas pump and priming line; in service 7 PM. Federal government released 895 mil gal from Bluestone Dam to freshen Kanawha River water. Pool gaining, 7¼ in. below intake. Musty odor in Slack Street and Coonskin water.

Oct. 6. Aerator pump trouble; think there is trash in eye of impeller; shut down to clean. Installed 1 × 2-in. mesh submerged fence around suction pipe; installed floating wood mat over suction pipe to break vortex swirl. River flow 2,700 gpm. Pool 7¼ in. below intake.

Oct. 7. Pool 7¼ in. below intake and falling. Backflushed aerator pump.

Oct. 8. Second gasoline pump installed on dam. Pool 6¼ in. below intake, now gaining. Water being sampled before and after aeration to determine extent of improvement. Rush order placed for

6,000-lb chlorine evaporator. Cleaned leaves and fish out of aerator nozzles.

Oct. 12. River flow 1,660 gpm. Pool 5½ in. below intake. Chlorine up to 3,500 lb for 12,500 gpm.

Oct. 13. Pool 5½ in. below intake. Chlorine up to 5,000 lb; couldn't get free residual; decided to operate on chloramine (natural ammonia present); 2,000 lb produced 6.0 ppm in basin; ammonia content indicates that Kanawha water has completely displaced Elk water in 41 days.

Oct. 14. Pool 5½ in. below intake; studies under way on location, piping, and electricity and air supply for 6,000-lb evaporator.

Oct. 16. Installation of 6,000-lb chlorine evaporator started.

Oct. 27. River flow 1,200 gpm. Evaporator put in operation.

Oct. 29. Started installation of chlorine dioxide generators. Drizzly rain fell. Tests showed about 50 per cent reduction in odors by aerator; 20–40-day travel of water up Elk Channel permitted free residual chlorination that much longer; chemical and varnish odor of Kanawha water was changed to musty, fishy odor.

Nov. 3. River flow 135 gpm. Chlorine dioxide generators put in service, before and after filtration.

Nov. 4. River flow 135 gpm. Pool 2½ in. below intake.

Nov. 5. Pool 2½ in. below intake. Two gasoline pumps running. Reverse flow in Elk River [see Fig. 1]. Chlorine dioxide abandoned, as no apparent reduction in taste and odors.

Nov. 6. River flow 990 gpm.

Nov. 13. River flow 4,200 gpm.

Nov. 18. River flow 8,550 gpm; took off both gasoline pumps.

Nov. 24. River flow 7,200 gpm. Pool ½ in. above intake.

Nov. 26. Back on free residual chlorination.

Nov. 29. Aerator pump taken off.

Nov. 30. River flow 13,000 gpm. All emergency pumps off. Removed some stop logs. Average flow for November 4,700 gpm.

Dec. 4. Pool 1½ in. above intake; five sluiceway pipes wide open.

Dec. 9. Pool 3½ in. below intake. Raining; think we will lose dam soon. Looks like siege is over; feeding 780 lb of chlorine.

Dec. 16. Pool 19 in. over intake, topped dam, and washed it out.

Dec. 18. River flow 314,000 gpm. Pool 15 in. over intake.

Dec. 19. Pool 3½ in. over intake.

These diary excerpts for the 4-month duration of the emergency in 1953 can only hint at the details, time, and effort involved in the planning, installation, and operation of the equipment; the mental and physical strain on the personnel; the extraordinary expense to the company; and the great relief when the rains finally came.

Henry R. Gay

Supt., Filter Plant, Water Board, Clarksburg, W.Va.

In the fall of 1953 Clarksburg, like many other communities in West Virginia, was faced with a shortage of water due to the very dry conditions prevailing over a large area at the time. The rainfall for the last 6 months of 1953 totaled only 10.46 in., about 50 per cent of normal. By comparison, 8.53 in. fell in August 1954 and 6.83 in. in October 1954.

The raw-water supply of Clarksburg is obtained from the West Fork River, which has a drainage area of 385 sq miles above the intake. The four storage dams on this stream have a total capacity of 425 mil gal, but 90 mil gal of this storage is not considered avail-

able, because it is below the intake and could not be used without considerable repumping. For a short period in July 1953 the pumpage exceeded the flow of the river, and the water level fell below the top of Dam No. 1. In the early part of August, however, there was enough rain to give a good flow over the top of the dam, but by Aug. 19 the flow was again less than the pumpage. This situation continued through September, with water being released from the upper dams to keep the level up in Dam No. 1. Conditions became increasingly serious, and on Oct. 25–26 the reservoirs were surveyed, revealing a total of 260 mil gal remaining, of which 90 mil gal was unavailable. At that time the pumpage from this supply was 4.5 mgd. The stream flow above Dam No. 4 became insignificant (0.2–0.3 mgd).

Early in November an unsuccessful attempt was made to augment the supply by draining some coal mines that had been abandoned for several years. Although many of these mines were full of water, only small amounts could be pumped out because cave-ins had dammed the water off at several places. There are no large ponds on the watershed that could have been used to help alleviate the situation. Steps were taken to reduce domestic consumption in the city. At the same time the managers of the larger industrial plants using water met with members of the water board and agreed to try voluntary conservation. The effectiveness of this step was indicated almost immediately by a sharp drop in consumption.

The moderate rains that fell late in November and early in December were not enough to restore the flow in the West Fork River to the volume needed, but other rivers that rise in the mountains began flowing. Some consideration was given to a plan for pumping water from the Buckhannon River over a distance of about 4 miles to the watershed of the West Fork River, but this measure did not become necessary. On Dec. 12 the dams began gaining, and on Dec. 16 water again started to flow over the dam at the filtration plant.

On Christmas Day considerable detergent contamination was experienced in the water, causing much foaming at the dam and giving a disagreeable taste to the water. The chlorine demand rose so greatly that the capacity of the chlorinators was insufficient to provide a free residual. A high carbon dosage did not seem to help the taste at all, but excessive contamination lasted for only a few days. High concentrations of manganese were also experienced at this time.

Even before the onset of the drought, the water board had authorized the addition of concrete piers to the dam at the filtration plant. Such piers, with slots for the insertion of flashboards in summer, were constructed during the fall and increased the storage capacity by about 70 mil gal. Temporary flashboards were also installed on the other dams, to provide additional storage during the summer of 1954.

The city is now planning to build a large dam on one of the tributaries of the West Fork River above Clarksburg. This 40-ft earth fill dam, with a concrete spillway, will furnish additional storage of 325–400 mil gal, almost equaling present capacity. The estimated cost is $675,000, including the purchase of land and appurtenances. It is hoped that the structure will be completed in time to catch the spring runoff in 1955.

The new dam is a part of an extensive improvement program to be financed by the sale of about $1,650,000 in revenue bonds. Other improvements will include two new 2-mil gal steel tanks for treated-water storage, new pumping equipment, and extension and reinforcement of the distribution system.

A. R. Todd

Supt. of Filtration, Water Works, Wheeling, W.Va.

The 1953 rainfall in the Wheeling, W.Va., area amounted to 22 in., 12 in. below the so-called normal. From Jun. 1 to Nov. 21, there was less than ½ in. of precipitation. This lack of rainfall caused springs to stop flowing and dried up many wells and all the creeks in the region. During this period a continual lineup of all types of vehicles could be seen hauling water from the Wheeling plants. In October alone, more than 300,000 gal was hauled from the filtration plant, and this was only one of four loading points. As a result, the output of the filtration plant was unusually large, but the plant had the capacity to meet the demand without suffering serious difficulty.

In November, however, after sufficient rainfall had occurred to cause dried-up creeks to start flowing again, it was noted that the first water from them to reach the Ohio River was a dark-brown, semiviscous liquid. This mixture of creek and Ohio River water, when received at the Wheeling plant, produced intense foaming, had an intense fishy odor, interfered with coagulation and settling, and caused "black water" to appear in the distribution system. Owing to the presence of foam, detergents were suspected. Approximately 70 tubs of foam were collected and brought into a warm room, where the foam reliquefied. The liquefied foam was analyzed and found to contain approximately 12,000 ppm of synthetic detergents. The river water was then analyzed hourly, and the detergent content was found to range from 1 ppm to 8 ppm; the surfactant (surface-active agent) content ranged from 0.2 to 1.4 ppm. In the author's opinion, the fishy odor was due to the detergents, to the drying out of wastes in the creeks (with detergent particles probably surrounding the wastes), and to the resulting bacterial action.

TABLE 3

Surfactant Content

Month (1954)	Surfactant—*ppm.*		
	Min.	Max.	Median
Jun.	0.34	1.24	0.61
Jul.	0.1	4.65	1.46
Aug.	0.0	1.7	1.0
Sep.	0.0	3.1	1.2
Oct.	0.0	2.7	0.9

After 6 days of trying various methods of dealing with the problem, it was found that, by raising the pH to 10.4, the odor, the foaming, and the interference with coagulation and settling could be overcome. The high pH brought on another difficulty, however, as it made chlorine dioxide ineffective against phenols; this trouble was corrected by coagulating in one basin at pH 10.4 and lowering the pH to 8.7 in the next basin before adding the chlorine dioxide. The pH of the finished water was then brought up to 9.3 in the clear well with caustic soda.

Wheeling has been making daily detergent determinations since November 1953. Table 3 summarizes the results for June–October 1954. It should be pointed out that: [1] during Aug. 2–5 and Aug. 17–Sep. 13, when the Ohio River water was acid, the detergent content was only about 20 per cent as high as when the river water was on the alkaline side; and [2] during the October flood the detergent content again dropped to a minimum. The second condition can be regarded as the effect of dilution, but the first requires another explanation. Perhaps the detergent is removed in an acid water by the ferrous sulfate present or as a result of biochemical oxidation, an action that may be favored in an acid medium.

Bern Wright

Asst. Engr., Div. of San. Eng., State Dept. of Health, Charleston, W.Va.

This paper will describe briefly the problems that were encountered by ten small West Virginia public water supply systems during the prolonged 1953 drought. The plans or improvements that have been or are being made as a result of the drought will also be discussed.

Richwood

The water supply system at Richwood serves approximately 5,200 persons. The plant normally secures its raw water from a very small impoundment on the North Fork of the Cherry River, which usually provides water of very good quality. The supply shortage became acute in August 1953. A number of wells had been drilled in the Cherry River Valley during the drought of 1930, but only two were in condition to be used in 1953, as they had all been out of service since 1930. The wells produced a poor-quality water, with hardness up to 240 ppm and a very high iron content.

Restrictions were placed on the use of water for car washing, lawn watering, and all other nonessential purposes. The situation became so critical that water was shut off except for 4 hr a day. Public consumption was cut by 120,000 gpd, almost half the normal demand. Four new wells were drilled, providing some immediate relief, but their water was generally of poor quality. Use restrictions were lifted on Oct. 15, 1954.

Plans are being made by the State Conservation Dept. to construct a 50-acre artificial lake on the North Fork of the Cherry River. Intended for public recreation, the lake will also serve as an emergency source of supply.

Whitman

The Whitman system serves approximately 1,500 persons. At the time of the drought Whitmans Creek was being used as a source, with lime-soda softening, filtration, and chlorination. A small stream impoundment, 100,000-gal capacity, was then in good condition, with relatively little sediment accumulation. The plant had a rated capacity of 100,000 gpd and the demand was about 93,000 gpd.

In late August 1953 Whitmans Creek dried up completely, and water was hauled from another system for a short period. Door-to-door campaigning, newspaper pleas, and radio requests for conservation by consumers failed to bring any appreciable relief. An emergency pump was installed at the discharge pool from a mine pump. The water was heavily chlorinated and pumped directly into the distribution system through a fire hydrant connec-

tion. This supply was used until January 1954.

Permission has since been obtained from the Island Creek Coal Co. for emergency use of water from an abandoned section of a mine, and a submersible deep well pump has been installed in a mine drill hole at a depth of approximately 300 ft. The piping necessary to run the water to the Whitman treatment plant has been laid. The water has been tested and found to be of satisfactory quality when properly treated.

Hurricane

The Hurricane system serves approximately 2,300 persons an average of about 96,000 gpd. At the time of the drought the system was securing water from a stream impoundment with a capacity of about 1.5 mil gal. After the issuance of handbills asking consumers to restrict their use of water to essentials, the demand was reduced to 75,000 gpd. Some welcome temporary assistance was also afforded by the release of a farm pond supply upstream from the surface impoundment.

A new well furnished 24,000 gpd, which, combined with 27,000 gpd from formerly abandoned wells and with the surface water available, made it possible to keep the storage tank full. The height of the dam at the surface impoundment is being increased by 3 ft to provide an additional 2–3 mil gal of storage, which would raise the total raw-water storage capacity to about 4–4.5 mil gal.

Ansted

The Ansted system serves about 1,800 persons, using Mill Creek as a source of supply. An impounding reservoir of about 3-mil gal capacity is available for raw-water storage. No spillway has been built, however, and the capacity is reported to be decreasing as a result of sediment accumulation.

During the drought restrictions were placed on the use of water for car washing and lawn sprinkling, and the schools were closed at times. Raw-water pumping was carried on at intervals, to obtain the maximum quantity. The town was never completely out of water, but it was necessary to secure about 90 per cent of the supply from coal mines during the shortage. Plans are being made to enlarge the reservoir and to build a spillway for the dam.

Cameron

The Cameron system, which serves approximately 1,800 persons, depends entirely upon drilled wells for its supply. At the time of the drought there were 33 such wells, all located along a small creek which, of course, dried up. The normal demand, about 55,000 gpd, was reduced to 40,000 gpd by public cooperation in conserving water. A 16-hr daily pumping schedule was adopted, with a 4-hr rest period between two 8-hr shifts. The situation became acute in August, and the town was forced to haul water from Clarksburg, W.Va. Two new drilled wells will furnish approximately half the present demand. Plans are being initiated to build an impounding dam in the near future.

Bethany

The Bethany system serves approximately 1,100 persons with 100,000 gpd. A small riprap dam across Buffalo Creek, the source of supply, impounds approximately 1 mil gal. Although the town never ran completely out of wa-

ter, it was necessary to go as far as 3 miles upstream from the plant and impoundment to obtain a supply from water holes by means of a portable gasoline motor-driven pump. The water was then treated as usual at the Bethany plant.

A new impounding dam will provide about 12 mil gal of raw-water storage for emergencies.

West Liberty

West Liberty, serving about 1,100 persons, secures its raw water from two stream impoundments having a combined capacity of about 3.5 mil gal. A drilled well is also available as a supplementary source.

The normal demand, about 44,000 gpd, dropped to approximately 40,000 gpd during the worst part of the drought. When the water shortage became acute, on Sep. 10, 1953, water had to be hauled from Wheeling. The town was at no time out of water. Two 700,000-gal conservation dams have since been constructed.

Harrisville

At the time of the drought the Harrisville system was obtaining water from several deep wells located on the flood plain of the North Fork of the Hughes River. Chlorination was the only treatment given the water. Consumer demand averages about 80,000 gpd. The well supply started dropping off, and the situation became very serious on Sep. 3, 1953. Efforts were made to obtain water from the river by bulldozing ditches to drain water holes located upstream from the plant. The river was powder dry at the plant site, however, and these efforts to secure a supply were ineffective, as the ground absorbed much of the water in transit and very little was available in the water holes to start with. Even with restrictions on use, the town was down to its last drop of water several times.

A 300-gpm filtration plant was placed in operation in July 1954. A concrete dam, nearing completion, will impound approximately 15 mil gal of North Fork water—equivalent to a 5-month supply at the present rate of demand. The wells are to be maintained for standby use.

Athens

Athens, a small college town, was using two or three deep wells in 1953. When their production fell to practically nothing, during September, efforts were made to conserve water by asking for public cooperation. The State Dept. of Health permitted the town to use a small surface source, provided that the water was heavily chlorinated. After a day or so, even this source gave out, and the town was dry again.

The college and other schools had to be closed for a few days on two occasions in order to build up storage. Some water was held in reserve for fire fighting at all times. During the most critical period it was necessary to haul water from Princeton, W.Va., to supplement the supply.

The town drilled a new well with a good yield, which restored conditions to normal. The new well is 360 ft deep, compared with 78 ft for the other wells.

Pennsboro

Pennsboro obtains its water from thirteen drilled wells. The water from nine of them requires iron removal

treatment, while only chlorination is necessary for the water in the other four. For several years the wells have failed to produce an adequate supply during dry seasons. When the 1953 drought aggravated the problem, the town was forced to haul water from the North Fork of the Hughes River and process it through the iron removal plant.

A 256-gpm treatment plant and a low dam on the North Fork are nearing completion. The dam will impound about a 30-day supply. The wells will be maintained for standby service in emergencies.

1954 Drought in Virginia—*Donald S. Wallace*

A paper presented on Nov. 4, 1954, at the Virginia Section Meeting, Richmond, Va., by Donald S. Wallace, Comr., Div. of Water Resources, State Dept. of Conservation & Development, Charlottesville, Va. This paper was prepared before the effects of the 1954 drought could be fully assessed, but their seriousness was already evident in many sections of the nation.

The 1954 drought seriously affected about two-thirds of the nation; in the South and Central States, it was comparable to the one experienced in the early 1930's. Record low runoff was reported in the Carolinas, Georgia, all of the Gulf States, and several of the midwestern and southwestern states. Many municipalities faced critical water shortages.

The Virginia Div. of Water Resources, in cooperation with the US Geological Survey, collects stream flow records at 192 gaging stations. Some of these data are for short periods, but many stations have records extending back to and before the drought of 1930–32. The division maintains five index stations, located on the Rappahannock River at Fredericksburg (northern Piedmont), the Slate River at Arvonia (middle Piedmont), the Blackwater River at Zuni (southeast Coastal Plain), the South River at Waynesboro (Shenandoah Valley), and the North Fork of the Holston River at Saltville (southwest Virginia). At all of these stations the stream flow began to fall rapidly in July 1954 and continued to drop throughout August and September; by the middle or end of September the runoff was approaching the minimum established in 1930. The accumulated deficiency in rainfall from January to October amounted to as much as 13 in. in some parts of the state. Until August southwest Virginia was in relatively good condition, but by the middle of September the flow in the New River was close to the previous minimum, and that at the station on the Holston was slightly below the previous minimum. The Roanoke River at Roanoke had a minimum daily flow of about 39 cfs, as against 30 in 1930; the Rappahannock River, with a watershed of nearly 1,600 sq miles, had a minimum of about 22 cfs, whereas 5 cfs was recorded in 1930. In general, all of the streams were extremely low early in October. Normally, the rainfall is less in October than in September and is lowest in November. With the streams so exceedingly low, and with the shallow ground water table also very low, prospects were for much trouble with municipal water supplies before the winter rains set in. Hurricane "Hazel," on Oct. 15, brought heavy

rainfall, relieving the situation in the Piedmont and western part of the state. The coastal area received only light rains during this storm.

A number of small communities experienced a serious water shortage in the summer and fall of 1954, and many others were threatened. It must be frankly admitted that many municipal water supplies do not have an adequate factor of safety. Difficulties are seldom encountered during normal years and the annual residual of precipitation over Virginia, after 25–30 in. has been deducted for evapotranspiration, far exceeds the existing demand. It has been estimated that the total consumption of water in Virginia is more than 3 bil gal per day, or about 1,100 bil gal per year. This estimate includes a huge quantity for industrial use—in fact, the industrial consumption is many times the municipal and rural use combined. Most of the water is used over and over as it travels downstream: a million gallons at the head of the James River may be used a dozen times before arriving at Hampton Roads. Records show a yearly average runoff of 15 in. As 1 in. of runoff over the 40,000 sq miles of Virginia would equal 700 bil gal, it is obvious that only a small fraction—perhaps as little as 2 per cent—of the total available supply is being used. Several factors must weaken the feeling of confidence in the surplus available on an annual basis. During a severe drought year, such as 1930, the annual runoff for some streams was only 3 in., for others only 5 in. Beginning in April 1930 there were about ten consecutive months of deficient rainfall. The recovery during the winter was low, and droughts of equal severity occurred in 1931 and 1932. Therefore, instead of 15 in. of runoff, only 3–5 in. can be relied on during a critical year. This amount would still be enough, were it not for the fact that it is distributed among all the rivers of the state and generally is far away from the point of maximum use. A third factor to consider is that about two-thirds of the runoff occurs normally during the winter and spring, leaving only one-third for the summer and fall.

Relative Severity of Drought

Recent drought conditions have been cumulative, commencing in the fall of 1951 and gradually getting worse every year since. Recovery has been so poor that at the beginning of spring 1954 there was deficient stream flow. In some parts of the state precipitation also began to be deficient in April, in other parts not until the end of May. There was a great deficiency in rainfall from June through September, and by October the flow at most water supply intakes was alarmingly low and in several instances had almost disappeared.

Table 4, which compares minimum daily discharges for 1930–32 and 1954 at a number of gaging stations distributed over the major river basins in Virginia, indicates the seriousness of the reduction in flow. There have been some statements that the 1954 drought was the worst on record. Generally speaking, it is almost impossible for the casual observer to compare current stream levels with 1930, because he depends on his memory, which is not a very accurate gage. Records of stream flow have been kept for only a relatively very short period. At five locations in Virginia, the records go back to 1900. However, certain observant individuals with a scientific bent have recorded facts about droughts since the early days of the

TABLE 4

Comparison of Minimum Flow at Selected River Gaging Stations
(Droughts of 1930–32 and 1954)

River Basin and Station	Drainage Area *sq mi*	Min. Daily Discharge—*cfs*	
		1930–32	1954
Potomac			
N. Fork Shenandoah R.—Cootes Store	215	0.4	1.2
N. Fork Shenandoah R.—Strasburg	772	41	60
S. Fork Shenandoah R.—Lynwood	1,076	93	185
Goose Creek—Leesburg	338	0.4*	8
Rappahannock			
Rappahannock R.—Kellys Ford, Remington	640	1	7
Rappahannock R.—Fredericksburg	1,599	5	22
Rapidan R.—Culpeper	465	5	3
York			
North Anna R.—Doswell	439	1	2.5
South Anna R.—Ashland	393	4	9.9
James			
Jackson R.—Falling Springs	409	58	66
James R.—Buchanan	2,084	259	270
James R.—Cartersville	6,242	348	539
Slate R.—Arvonia	235	2	10
Appomattox R.—Mattoax	729	13	37
Chowan and Roanoke			
Nottoway R.—Stony Creek	586	5	5
Meherrin R.—Lawrenceville	553	5	5
Roanoke R.—Roanoke	388	30	39
Roanoke R.—Clover and Randolph	3,230	213	264
Dan R.—South Boston	2,730	208	320
North Mayo R.—Spencer	108	20	19
New			
New R.—Galax	1,131	285	265
New R.—Glenlyn	3,768	820	1,320
Tennessee			
N. Fork Holston R.—Saltville	222	20	24
Clinch R.—Cleveland	528	42	72
Clinch R.—Speers Ferry	1,126	77	99
Powell R.—Jonesville	319	18†	18

* 1941. † 1933.

settlement of Virginia. Some of these observations appear in old newspapers or in other historical writings. The author has not done sufficiently extensive research on these old records to be in a position to make comparisons, but one history of Albemarle mentions a drought in 1806 when the Rivanna River at Charlottesville was so low that a man could stop it with one hand; another description refers to "a thread of current no greater than a man's forearm." This would indicate that only a trickle of water was present.

There was not much more than a trickle in 1930, but, although the river was very low in 1954, it was still several times the size of a trickle. Judging from this, the author would estimate that the drought of 1930 had a frequency of about once in 100 years, whereas the drought of 1954 might have a frequency of about once in 50, or perhaps 25, years.

Many of the early writings, and even some newspaper accounts today, describe drought in terms of crop failures, without any reference to stream flow, although sometimes the comment is made that "wells are running dry." It is possible to have a severe, but short-term, drought which will hurt crops and pastures but will not affect the water table or streams too greatly. For instance, if there is practically no rain in July, the crops will be in a bad way by Aug. 1, but, if it rains in August, the streams will not be too seriously affected. Such conditions may, in earlier years, have caused some droughts to be reported as severe although the streams may not have suffered. For streams to be severely affected, several months of cumulative deficiency are required.

Need for Storage

It is probable that sometime in the future there will be a worse drought—and a worse flood—than any so far experienced. In designing water systems, engineers must make provision for an adequate supply during the worst conditions rather than during times of normal flow. This statement applies whether surface or ground water sources are used. Although fluctuations in deep well levels are ordinarily not sufficient to cause much alarm, the rapidly increasing consumption in many areas often exceeds the yield, while the yield from streams is not enough either during dry periods. Consequently, it appears that there is an imperative need for greatly increased storage facilities in most water systems. The chances of obtaining the water needed are good, but it can no longer be had at the extremely low cost possible heretofore. Water works men will have to do more to inform the public in order to obtain support for the investments necessary to insure adequate water in the future. The public, generally, is receptive to a sound, honest statement of what is required and will respond to a forward looking, intelligent solution to water problems.

Irrigation Use

A development new to Virginia occurred during the drought of 1953–54: a rapid expansion in the use of water for irrigation. The heavy diversion or withdrawal of water from a number of streams in the summer of 1954 reduced the flow downstream to an amount which alarmed downstream users. At a number of gaging stations, the low flows registered during the current drought were considerably less than what would have occurred without irrigation. This factor must be given weight in making comparisons of flow between the 1954 and 1930 droughts. During the record drought of the 1930's there was no such withdrawal as is now taking place to irrigate farm lands. It seems certain that irrigational use of water will increase in the future and aggravate the municipal and industrial water shortages. This suggests that there will be very difficult problems ahead and undoubtedly much litigation over water rights. The situation calls for a careful study of water requirements and resources, so that constructive action can be taken to meet the demands of the future.

Growth of Eastern Irrigation Demands—*Beverly C. Snow*

A paper presented on Nov. 9, 1954, at the North Carolina Section Meeting, Asheville, N.C., by Beverly C. Snow, Chief Engr., Div. of Water Resources, Inlets & Coastal Waterways, State Dept. of Conservation & Development, Raleigh, N.C.

Until recently the use of water for irrigation purposes was regarded as being limited to the western part of the United States, chiefly the arid sections west of the 100th meridian. At present there is a drive toward the building of giant dams in the western states, with billions of dollars involved. At the very most, the irrigationists, dreaming and speculating on what they can do with dams, canals, and irrigation ditches, hope to supply crop water to no more than 19,000,000 acres in addition to the 20,000,000 acres being irrigated in 1950. If it takes an average of 2 acre-ft of water to grow crops, the added annual water demand for western irrigation will be 38,000,000 acre-ft, or approximately 12,000 bil gal.

In the past practically all agriculturists east of the 100th meridian, from those engaged in the most extensive types of farming to those who grow vegetables and fruits, put their trust in getting sufficient rain at the right time to mature crops. Now, through the stimulus of increasingly severe drought, the failure of experiments with drainage, the lowering of ground water levels by mounting demand, or the action of other factors, the East has discovered irrigation. More and more farmers are realizing that it is cheaper to irrigate than to lose crops to drought. Irrigation to supplement dwindling water supplies is not a new idea, but the wide use of supplemental irrigation in the East is new, and droughts like the one experienced in the southeastern states during the summer of 1954 will cause the idea to spread even further.

Experts have told South Carolina farmers that irrigation is the answer to many of their problems. It can remove a great deal of the risk from farming where 10–14 days without rain can kill or cripple a crop. In Virginia, a legislator has called irrigation "the missing link in maximum production on southern farms." Irrigation of high-value crops is already fairly common in Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Delaware, and Florida. The subject is also of grave concern in Indiana and Ohio.

The greatest use of fresh water in the United States is for irrigation. In 1950, 26,000,000 acres of irrigated land received about 50 per cent of all freshwater withdrawals. It is estimated that irrigation accounts for more than 80 per cent of the total consumptive depletion of water. Approximately 18 per cent of the fresh water withdrawn for irrigation is obtained from wells, mostly pumped. In California alone, the gross total pumpage in 1950 was 10,000,000 acre-ft, which is about 40 per cent of the total pumpage in the United States.

On Aug. 9, 1954, at an irrigation conference in Raleigh, N.C., attended by farmers and by representatives of six state and two federal agencies, it was generally agreed that the use of water in North Carolina for irrigation is increasing greatly, that a survey of North Carolina waters should be made with a view to their conservation, that legislation covering the whole water problem is needed, and that owners of

land on the banks of streams must be protected against the construction of dams or other damaging use of water by upstream landowners. Some of the statements made at this conference are worth summarizing:

North Carolina farmers are willing to incur the expense of irrigation, provided that the cost is justifiable and that it is more expensive not to irrigate. The best type of irrigation equipment consists of portable pumps and revolving sprinklers. The number of acres of tobacco irrigated in North Carolina increased from 500 in 1951 to 6,000 in 1954. Some of the mistakes being made by farmers in purchasing irrigation equipment are: [1] failure to make certain of an adequate supply of water; [2] insufficient attention to proper design; and [3] improper diagnosis of the situation, resulting in inefficient use of water without irrigation. Before adopting an irrigation system, numerous aspects of the problem must be studied, including return on investment, costs, engineering, root habits of plants, changes in soil content, and time of demands for water by various plants. Irrigation is important because the cropland per capita is decreasing and income per capita is low. High-pressure salesmanship in connection with irrigation will get farmers into trouble. More and better skilled labor is needed for irrigation. Crop yield and quality are improved by irrigation, thus increasing profits. Everyone is irrigation conscious, but very few have practical knowledge of the subject. A flood of applications for loans to buy irrigation equipment has been received.

Much of the irrigation in the East has been accomplished through the use of overhead sprinkler systems. One might think that, if water is spread on the land by sprinklers, most of it would eventually become part of the ground water supply. Actually, however, the bulk of the water is drawn out of the surface soil by the plant roots and exhaled through the plant tissues or evaporated directly from the soil, to become moisture content in the air and be carried away by the winds.

Farmers in the West are beginning to use the sprinkler type of irrigation. Formerly the standard procedure was to lead the water to the fields in ditches and let it spread by running it between crop rows. This method is not feasible unless the land is accurately graded. It must be nearly level, so that the water will flow slowly and soak into the ground. To level off the land requires a considerable outlay of money. There may be spots in a field where the topsoil must be removed from a little hump, the subsoil cut down, and the fertile soil spread back where the high spot had been. This expensive practice means an increase in capital investment, which the use of sprinklers can avoid. The application of water in spray form can moisten a hillside that would otherwise be too steep to plow with any hope of retaining the topsoil, because the water in the irrigation ditches would run too fast and continually remove the soil. The sprinkler can moisten a slope gently, avoiding erosion but permitting the growth of crops that need quantities of water.

The increasing use of water for irrigation purposes in the eastern United States is giving rise to a serious legal problem. Water law in the East is not nearly so well developed as in the semiarid and arid West, where water rights are governed by the principle of prior appropriation. An example can best explain this principle. A western rancher a mile away from a creek builds a ditch to his fields, diverting

the flow of that stream. Later a homesteader settles directly on the creek and wishes to use its flow. Even though he has riparian rights under the English rule (discussed below), the principle of prior appropriation applies. The rancher, who already had established his rights, would have first call on the flow of the creek. Furthermore, if another rancher, miles downstream, had made use of the water at a date prior to its use by the rancher who preceded the homesteader, both of the latter would have to let the water flow on down the channel to satisfy the rights of the earliest appropriator.

In western states, rights to water have been fixed on almost every flowing stream and even on the flood waters above normal flow. The laws were drawn to meet the demand for irrigation water, with very slight regard for other water uses. Cities often have to buy out irrigators in order to secure rights to water. Industrial and recreational users encounter the same problem. The water law of the West, developed chiefly to regulate irrigation uses, is complicated and difficult to understand. New developments in policy and legal action may be engendered by the principle that water resources must be so managed that all beneficial uses will be served. Efforts to attain this objective, however, will meet a solid barrier of established law drawn to serve requirements of years past.

The doctrine governing water rights in North Carolina and the other older states of the East is based chiefly on the English rule that title to the land includes title to all its physical appurtenances. Thus, a landowner has a property right in a stream flowing through or by his holdings. He may use it, but the next property owner downstream has the same rights to the water. The English, or riparian, rights doctrine is an oddly roundabout recognition of the public title in water. Each landowner along a stream is entitled to the original, unimpaired flow of that stream. If any landowner feels that his riparian right has been invaded by someone else, he can obtain redress only in a court of competent jurisdiction.

In 1953 South Carolina began consideration of a new law based on the doctrine of prior appropriation, the western doctrine. The proposed legislation is contained in a 1954 joint-committee report submitted to the state assembly. Under the proposed law, a newly created state board of water commissioners would issue permits for water use on a priority basis, in this order: domestic, municipal, irrigational, industrial, recreational, and hydroelectric. No bill on the subject was introduced at the 1954 session of the assembly, because differences of opinion that developed in the hearings were not reconciled. Most observers in South Carolina believe, however, that the new water doctrine will be enacted in 1955. Drought-stricken farmers, convinced of the future of irrigation, realize that they will find it hard to get water for this purpose unless some orderly legal system is set up. The chances are good, too, that water legislation will come up in the 1955 Georgia legislature. And in Alabama, Mississippi, Michigan, Indiana, and half a dozen other states east of the Mississippi River, consideration is being given to the subject.

Congress in 1954 extended the Water Facilities Act to cover the entire country. Formerly limited to seventeen western states, this act makes loans available to individual farmers or groups for the development of farm water supply or irrigation systems. With the East and South becoming

more interested in supplemental irrigation as a result of the drought, the broadened act will encourage better use of farm water and further increase the demands for water for irrigation purposes.

Aside from the principle of riparian rights, as established by English law and interpreted from time to time in decisions of state courts, there is only one North Carolina law pertaining to the use of water. This act, contained in Subsection 113–8.1 of the General Statutes of 1943, as amended, reads:

> Any person, firm, or corporation utilizing waters of North Carolina taken from the streams, rivers, creeks, or lakes of the state in such an amount as to substantially reduce the volume or flow thereof for the purpose of irrigation shall, before utilizing this resource in this manner, make application to the Director of the Department of Conservation and Development for a permit for such use. Such person, firm, or corporation shall file with the Department of Conservation and Development a proposed irrigation plan and survey. The Director of Conservation and Development is hereby authorized to investigate such a plan as to safety and public interest and to approve plans and specifications and issue permits.

It will be noted that this law is not punitive. Any unauthorized user of surface water for irrigation may continue his illegal use without fear of retribution other than through legal action by a landowner who believes that he has been dispossessed of his riparian rights. It may also be noted that the law is silent with respect to the use of ground water for irrigation. Thus, irrigational use of ground water is legally unrestricted.

In January 1954 the State Board of Conservation and Development adopted a resolution calling for an up-to-date water code and for the conservation and wiser utilization of North Carolina's water resources. The resolution also requested the governor to appoint an advisory water committee of seven men to work with the board's committee on water resources in formulating the recommended program. The advisory committee has been appointed, and consideration of new legislation is under way. It is believed that the proposals are similar to those pending in South Carolina. Interested state agencies and industry, farm, and other groups will, it is assumed, be given opportunities to participate in framing the legislation.

Meanwhile funds have been allocated to the State Dept. of Conservation and Development for use in making an inventory of the water resources of North Carolina. This work, begun in September 1954 by the Div. of Water Resources, Inlets, and Coastal Waterways, has made substantial progress. The inventory will provide information to legislators and others who may desire it in connection with studies of proposed water legislation, will supply material for use in a contemplated public education program, and will furnish urgently needed advice and assistance to farmers concerned with the purchase and use of irrigation equipment. Moreover, the inventory report should prove of great value to whatever agency is established to administer any new North Carolina water legislation enacted.

Acknowledgment

Some of the material in this paper was based on *Water—Or Your Life*, by A. C. Carhart (J. B. Lippincott Co., Philadelphia; 1951), and on "There's Urgency Now in Controlling Water Use" (*Eng. News-Rec.*, **153**:9:21; Aug. 26, 1954).

Artificial Recharge of Ground Water Reservoirs

Ralph A. Scalapino

A paper presented on Oct. 18, 1954, at the Southwest Section Meeting, El Paso, Tex., by Ralph A. Scalapino, Geologist, William F. Guyton, Austin, Tex.

ARTIFICIAL recharge of ground water reservoirs has been carried on for many years in various places in Europe and the United States. Two of the earlier projects in the United States were undertaken at Denver, Colo., in 1889 and in the San Antonio River Basin, Calif., in 1895.

The unprecedented rise in population and industrial activity in the West in recent years has been accompanied by a similarly unprecedented reduction in ground water storage. Several areas, notably California, have begun artificially replenishing the ground water that is being pumped in large quantities to meet the demands of new industries, increased population, and irrigation.

According to a recent report (*1*) by Harvey O. Banks, assistant state engineer, there are at least 87 recharge projects in operation in California. Most of them utilize the practice of water spreading, which consists simply of diverting water from natural surface channels and spreading it over adjacent porous formations. Records supplied by Banks show that 1,754,520 acre-ft of water has been artificially placed in ground water reservoirs in California since 1941. Banks states that this figure by no means represents all the water artificially recharged, as records have not been kept on many of the projects and many were in operation prior to 1941. Artificial recharge by water spreading is carried on elsewhere, but California has made by far the greatest use of this practice.

Artificial recharge in the Southwest has not been conducted on a large scale. There are, however, several experimental projects in Texas. A recharge well has been drilled on the King Ranch, near Kingsville, Tex., for the purpose of placing in the ground the water captured in a lake near the well. The installation includes a pump, a gravel filter, a diatomaceous-earth filter, and a gravel-packed recharge well. According to T. B. Stanley Jr., a geologist for the Humble Oil and Refining Co., the project has met with only limited success so far. The chief difficulty at this installation has been the failure of the diatomaceous-earth filters in the early stages. This allowed the silt, algae, and other material in the water, together with some diatomaceous earth, to enter the well. The sand face opposite the well screen became clogged, and the well has not yet been successfully cleaned. After the initial difficulty the diatomaceous-earth filters were improved and a gravel filter was added to the installation. It is believed that, when the well is cleaned, it will take water at near its original capacity, about 750 gpm. In addition to the filter treatment, the water is chlorinated to help control bacteria and algae.

The High Plains Underground Water Conservation Dist., which covers most of the southern plains area of Texas, has undertaken experimentation on artificial recharge; water that collects in the many depressions in the region is drained through recharge wells located in them. It seems that silt clogging the sand face will also prove to be the major problem there. It is believed, however, that this trouble may be overcome by redeveloping the recharge wells at regular intervals to remove the silt.

Fig. 1. Fractured Limestone at Spreader Dam Site

The Edwards limestone reservoir in south central Texas is highly cavernous and porous.

An area in south central Texas, stretching about 250 miles from Del Rio to Austin, is served by ground water from the Edwards limestone reservoir, a highly cavernous and porous formation (see Fig. 1). Heavy withdrawals for irrigation in Uvalde and Bexar counties, and at San Antonio for industries, military posts, and municipal supply, are approaching the perennial yield limit of the Edwards reservoir. The Uvalde County commissioners have undertaken an artificial-recharge project which consists of building low dams across some of the streams that flow over the Edwards limestone outcrop, and placing steel grates over the openings of large caves in the stream beds (see Fig. 2). The purpose of the grates is to keep trash, boulders, and trees from washing into the caves, while the dams hold the water back, causing it to spread over a larger Edwards limestone surface than it would by flowing in the normal stream channel. The first of these projects was built 14 years ago. Although they have apparently operated successfully, there are no specific data to show how much actual recharge has been accomplished.

Another type of installation, not properly for artificial recharge, but rather for temporary storage of ground water, is being contemplated at Amarillo, Tex. The purpose of this project is the pumping of water in winter from one well field to another closer to town, so that, during the peak demands of summer, it will not be necessary to transport so much water from the distant well field. This enables a smaller-diameter pipeline to be used. Experimentation on this project is now under way to determine its feasibility. Another locality in Texas that might well utilize this system is Odessa, which gets its water from the Colorado River Municipal Water Dist., largely through a pipeline from distant sources. Because the line has a limited capacity, it will be necessary eventually to build large surface storage installations near the city to provide for peak demands. There is a ground water reservoir available nearby, however, in which it might be feasible to store water during

the winter for pumping during summer peak demands. This might eliminate the need for part of the large open surface storage or for the installation of additional pipeline capacity. Underground storage of gas has been carried on by the petroleum industry for many years, and undoubtedly underground storage of water has a great future in areas where it is practicable. The principal advantages of underground storage over surface storage are smaller initial investment, reduction or elimination of evapotranspiration losses, and elimination of capacity loss by siltation.

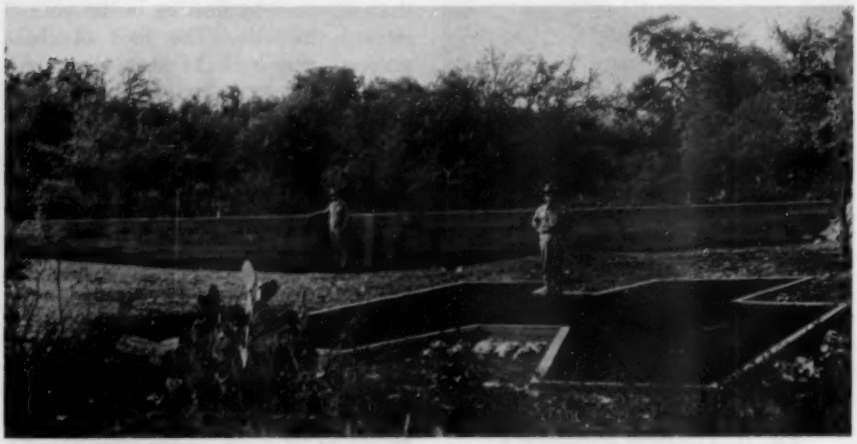

Fig. 2. Spreader Dam and Steel Grate Over Cave Opening

The low dam spreads the water over a large limestone surface; the steel grate keeps debris from washing into the stream bed cave.

Tests have been conducted during four winter periods since 1947 at El Paso, Tex., to determine the feasibility of storing river water in the ground water reservoir from which the city's principal supply is drawn. In order to determine the capacity of the reservoir and its ability to transmit water, pumping tests were first made in the Montana well field, in which the water was to be placed. Coefficients of transmissibility and storage were calculated by the use of the Theis nonequilibrium formula. The coefficients thus obtained were used to calculate the amount of rise that would occur in the water level when the aquifer was recharged at various rates and times. Then, in order to determine the accuracy of the computed effects of artificial recharge, an actual recharge experiment was run.

Treated surface water from the El Paso Water Dept. plant, carrying the normal chlorine residual for city water, was placed in the ground through Well No. 4, located in the Montana field. A recharge rate of 500 gpm was maintained for 3 days, and 700 gpm for 9 days. The water levels were measured in Well No. 1, which is 1,000 ft from the recharge well; Well No. 3, 3,450 ft away; Well No. 18, 4,000 ft away; and an abandoned well (at Loretto College), 3,200 ft away. The water levels were measured at regular inter-

vals for several days before recharge began and at frequent intervals during the period of recharge.

Coefficients of storage and transmissibility obtained from the pumping tests were used in computing the rise that should have occurred in the water levels of the observation wells as a result of the artificial recharge during the 12-day period. The actual and computed effects in each of the four wells are compared in Fig. 3. If the effect of recharge on the water level of an aquifer is equal and opposite to the effect of pumpage, these curves should nearly coincide, and this proved to be so. There was no apparent decline in the rate at which the well would take water at the end of the recharge period.

In a later experiment, more than 88 mil gal of river water was injected into the ground water reservoir. Pumping was started 10 days after recharge had stopped, and water samples were collected at frequent intervals so that analyses of the sulfate content could be made. The natural ground water contained about 60 ppm sulfate and the recharge water averaged about 408 ppm. Computations made by the US Geological Survey, based on the sulfate content of the water, showed that 95 per cent of the water injected was recovered. It seems probable that errors inherent in the method of study were responsible for the 5 per cent not shown as recovered.

In 1928 Well No. 4 yielded 1,360 gpm with a drawdown of 75 ft after several hours of pumping, showing a specific capacity of 18.1 gpm per foot of drawdown. During four recharge periods since 1947, a total of 177.5 mil gal of water has been injected through Well No. 4. During the last recharge period 55 mil gal was injected at an average rate of 702.5 gpm for about a month, and 772.7 gpm for another month. At the end of this period the water level in the recharge well had risen 43.5 ft, and the well was thus taking water at the rate of about 17.8 gpm per foot of rise. This figure indicates that the specific capacity of the well was about the same during this period as when the well was originally completed, even though the period of recharge was much longer than the initial pumping test. It seems that alternately recharging and pumping Well No. 4 has not impaired its ability

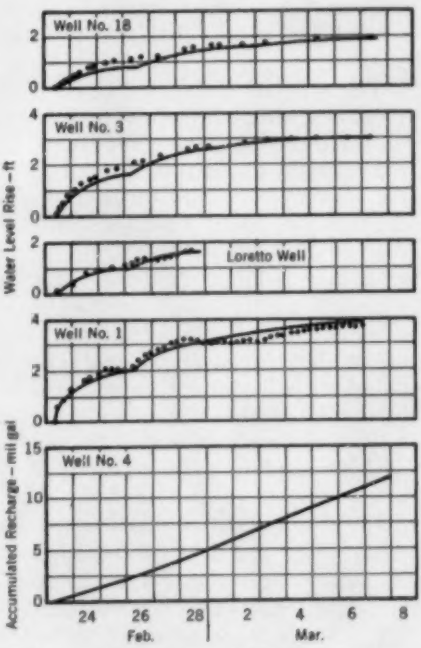

Fig. 3. Water Level Rise in Wells at El Paso, Tex.

Treated surface water was pumped into Recharge Well No. 4 for 12 days. The points show the actual observations and the curves the theoretical rise. Well No. 18 is 4,000 ft from Well No. 4; Well No. 3, 3,450 ft; Loretto College Well, 3,200 ft; Well No. 1, 1,000 ft.

to take or produce water. These results are in direct contrast with those at some other recharge well installations. The exact cause of the relatively better performance at El Paso is not known, but it may be the method of introduction of the water, together with the use of water more completely filtered and treated than that in other projects.

The artificial recharge project at El Paso was undertaken for two reasons: to determine the storage capacity of the reservoir in the area of influence of the recharge well and to determine if the pressure in the artesian area of the El Paso region could be raised enough to stop the encroachment of salt water into the fresh-water aquifers, a condition that was becoming apparent in the Montana well field. Computations indicate that water could be injected into the Montana field at a rate of about 6 mgd during the winter without causing lower-elevation wells in the downtown area to flow.

Definite retardation of salt water intrusion into the field has so far been shown only in the recharge well itself. It seems reasonable, however, to expect that, if large quantities of water are injected into the Montana well field for a considerable period, the rate of salt water encroachment can be slowed in many parts of the area, and even halted in some places. A project for the express purpose of excluding salt water from fresh-water aquifers in the Manhattan Beach area in Los Angeles County, Calif., is reported to be proving successful. Although El Paso and Manhattan Beach problems differ in some respects, it seems likely that satisfactory results can also be obtained in El Paso.

In determining the feasibility of any recharge project, the economic factors involved must not be overlooked. The costs of injecting or spreading the water to increase storage in ground water reservoirs must be carefully weighed against the results expected. Although several successful recharge projects are being carried on in the United States, few statistics on costs are available. Finley B. Laverty, after a study of projects in Southern California, reported (*2*) that the total cost of water injected through wells may be high, from $15 to $25 per acre-foot, while costs of spreading infrequently recurrent flood waters have not exceeded $8.00 per acre-foot for installation and operation. A more comprehensive analysis of costs and benefits is now being made in California by the State Div. of Water Resources. In some places it may be found that recharging ground water reservoirs, although a good conservation practice, is not the most economical method of meeting water supply problems.

This discussion has considered only a few of the areas carrying on artificial recharge and only one area in detail, but it is hoped that the feasibility of recharge in many regions where proper conditions exist has been indicated. Before any large scale project of this type is undertaken, however, the geology and hydrology of the ground water reservoir to be recharged should be thoroughly investigated, just as proposed surface reservoirs are studied to determine the suitability of the reservoir site and the ratio of costs to benefits.

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Bacteriological Study of Drinking Fountains

W. L. Mallmann and Antone K. Fontes

A contribution to the Journal by W. L. Mallmann, Prof., and Antone K. Fontes, Graduate Asst., Dept. of Bacteriology & Public Health, Michigan State College, East Lansing, Mich.

MUNICIPAL water supplies today are free of health hazards as the water flows from the consumer's taps, but a safe drinking water can be transformed into one which is potentially hazardous by the method of dispensing. Insanitary drinking receptacles, such as beverage glasses, may be responsible for disease transmission, and contamination may result from back siphonage or cross connections with unpotable water systems. Another possible means of contamination may be the drinking fountain, depending upon its design and maintenance.

In 1909 the health authorities in Kansas, realizing that the common drinking cup was a health hazard, initiated the first law prohibiting it in public places. The bubble fountain or single-service paper cup was recommended as a replacement for the badly contaminated common cup. In 1914, however, Berry (*1*) reported that, instead of being a sanitary improvement over the common cup, the bubble fountain was as much a health menace as the former. On the basis of these findings, recommendations were made to redesign the bubble fountain so that the stream of water always rose above the surface of the bubble cup.

Pettibone, Bogart, and Clark (*2*) examined bubble drinking fountains following an epidemic of streptococcus throat infections at a university. Streptococci were recovered from 50 per cent of the drinking fountains. Inasmuch as the water supply was satisfactory, the fountains were apparently the means of disease transmission. Test organisms seeded on the bubbler were recovered from the fountain after 135-min contact. No organisms were recovered from the parts or water stream of a fountain which projected a stream of water at a 50-deg angle from the water orifice.

Whittaker (*3*) reported that 80 per cent of 77 vertical-jet drinking fountains examined were contaminated. He recommended the use of a guard to prevent contamination. Dieter (*4*) also found vertical-jet drinking fountains unsatisfactory. He inoculated the streams with a glucose broth culture of *Serratia marcescens* and was able to recover the organisms 5 min later. Incorporating sputum into the culture, he was able to recover the organisms for 48 hr. This was accounted for by eddying effects caused by differences in velocity of the water in the center and periphery of the stream.

Dunlap (*5*) reported that most sanitary problems associated with vertical drinking fountains were due to poor design. Dunlap, Hinman, and Maffitt (*6*) reported that both continuous- and intermittent-flow vertical-jet drinking fountains were insanitary. These

workers also recommended a slanting-jet fountain with a guard over the orifice.

Dieter (*4*), investigating angle-jet fountains, found a few cases of contamination. In a series of experiments, he noted that the contamination was erratic.

Hitchens and Ross (*7*) reported that bacteria remained from 30 min to 2 hr on fountain parts that had been contaminated experimentally. In one instance, the test organisms which had been smeared on the bowl were recovered from the orifice. The authors stated that splashing water in the bowl might disseminate bacteria in the surrounding environment.

The possibility of disease transmission by drinking fountains is attested by the actual isolation of pathogenic organisms from fountains. Stiles (*1*) recovered *Corynebacterium diphtheriae* from a vertical fountain. Hitchens and Ross (*7*) isolated tubercle bacilli from the drain pipe of a drinking fountain. They also recovered beta hemolytic streptococci from all fountain parts. Dieter (*4*) isolated *Esch. coli* from the orifice of a vertical-jet fountain. Ingram (*1*) stated that "There is a dearth of epidemiological evidence, of what might be called positive evidence, that drinking fountains are not involved as a vehicle of disease transmission, whereas, on the other hand, there does exist a mass of circumstantial evidence which makes drinking fountains suspect, if not proven, vehicles."

The effect of aerosols in connection with drinking-fountain sanitation has not been investigated. As previously stated, Hitchens and Ross (*7*) mentioned the possibility of bacterial transference by splashing water. Anderson, Moss, and Gross (*8*), studying the effect of aerosol contamination from bacteriological techniques, demonstrated that, when drops of media containing bacteria fell from a pipet to a hard surface, the bacteria were disseminated by aerosols. The authors showed that these bacterial aerosols remained suspended for a considerable period.

School Fountain Tests

A survey of drinking fountains of various designs was made by the present authors. Public school fountains were selected because all age groups would be represented. Four types of fountains were checked in the survey: bubble, vertical-jet, angle-jet without an orifice guard, and angle-jet with an orifice guard. In addition, four refrigerated angle-jet drinking fountains in office buildings were examined. The water is reported to contain 0.05 ppm free residual chlorine, with a total (free and combined) residual of 0.3 ppm. The chlorine content of samples used in the tests was not checked by the authors.

Because the drinking fountains in public schools are used mostly during recess, samples were collected immediately after these periods. The technique of collecting the samples consisted of rubbing a sterile cotton swab, which had been moistened in sterile Butterfield buffer solution (*9*), over the surface to be examined. The swab was immediately placed in a vial containing 10 ml of buffer solution. Water samples were also collected from the fountains to determine if the water had been contaminated by contact with the orifice of the fountain. All samples were collected in sterile, 4-oz, salt-mouth, glass-stoppered bottles containing thiosulfate, as prescribed in *Standard Methods* (*10*).

The fountain parts selected for examination were the orifice, the bowl, and the orifice guard. Immediately after sampling, the swabs and water samples were taken to the laboratory. Ten-milliliter portions of the samples were placed in each of five tubes of double-strength lauryl tryptose broth * for the detection of coliform organisms and in each of five tubes of double-strength dextrose azide broth * for the detection of streptococci. The coliform-organism and streptococcus populations are reported as most probable number (MPN).

The swab vials were shaken until the cotton was fluffy, to insure maximum removal of the organism from the swab. Then 1-, 0.1-, and 0.01-ml portions of the swab rinse were planted in tryptone glucose extract agar * to ascertain the total number of bacteria present. Similar dilutions of the swab rinse were planted in single-strength dextrose azide broth.* All plantings were incubated at 37°C for 48 hr.

Water from a bubble drinking fountain used by students in Grades 9–12 did not contain any coliform organisms, but the streptococcus indexes varied from 2.2 to 39, with an average of 11.8 (Table 1a). The contamination is readily understood when it is observed that the indexes obtained from the orifice varied from 3.6 to 430, with an average of 205.7. The bowl streptococcus indexes varied from 22 to more than 1,000. These results confirm previous studies, proving that bubble type fountains are frequently contaminated.

In Table 1b are presented data on an unshielded angle-jet fountain used by schoolchildren in Grades 1–8 over a period of 8 days. Neither streptococci nor coliform organisms were found in the samples of water examined. In all examinations, streptococci were isolated from the orifice, the indexes ranging from 3.6 to 250, with an average of 123.7. Streptococci were isolated from the bowl in all instances, the indexes ranging from 24 to 920, with an average of 371. These results are certainly not unexpected, inasmuch as the angle jet was exposed to direct mouth contamination by the user.

The degree of contamination that occurred on a shielded angle-jet fountain used by schoolchildren in Grades 1–8 for 8 days is shown in Table 1c. No coliform organisms were found in the water supply, but streptococci were detected in one sample of water. Three samples failed to show streptococci on the orifice, but the other five samples showed streptococcus indexes ranging from 3.6 to 43. The orifice guard showed streptococcus indexes ranging from 3.6 to 9.1. The bowl yielded indexes ranging from 9.1 to 920, with an average of 350.2.

In Table 1d are presented data on a fountain similar to that in Table 1c but used by schoolchildren in Grades 9–12. Again no coliform organisms were found in the water, but streptococci were detected in one water sample. Streptococci were isolated from the orifice in all samples, the indexes ranging from 3.6 to 250, with an average of 78.1. The orifice guard yielded indexes ranging from 0 to 9.1, with an average of 5.9. The bowl had indexes ranging from 0 to 920, with an average of 210.7.

The data presented in Table 1c–1e, inclusive, show that buccal streptococci are found on all parts of the drinking fountains, irrespective of the type of fountain examined. The fact that

* Products of Difco Labs., Inc., Detroit, were used.

TABLE 1

Drinking-Fountain Contamination

Day	Streptococci per Swab—MPN			MPN Index of Water	
	Orifice	Guard	Bowl	Streptococcus	Coliform
(a) Bubble Type (Grades 9–12)					
1	430		430	2.2	0
2	3.6		1,000+	16	0
3	118		1,000+	39	0
4	230		22	5.1	0
5	92		74	9.2	0
6	430		45	9.2	0
7	250		430	5.1	0
8	92		920	9.2	0
(b) Unshielded Angle-Jet Type (Grades 1–8)					
1	92		92	0	0
2	3.6		24	0	0
3	92		250	0	0
4	250		250	0	0
5	118		92	0	0
6	250		430	0	0
7	92		920	0	0
8	92		920	0	0
(c) Shielded Angle-Jet Type (Grades 1–8)					
1	9.1	3.6	220	0	0
2	0	9.1	430	0	0
3	0	3.6	920	0	0
4	43	9.1	9.1	2.2	0
5	3.6	3.6	9.1	0	0
6	0	3.8	920	0	0
7	15	9.1	147	0	0
8	3.6	9.1	147	0	0
(d) Shielded Angle-Jet Type (Grades 9–12)					
1	250	9.1	430	0	0
2	43	9.1	250	0	0
3	3.6	3.6	0	5.1	0
4	9.2	9.1	24	0	0
5	4.3	3.6	15	0	0
6	3.6	0	3.6	0	0
7	9.1	3.6	920	0	0
8	24	9.1	43	0	0
(e) Refrigerated Angle-Jet Types (Various Designs)					
Fountain No.					
1	63	52	1,000+		
2	22	0	370		
3	18	24	1,000+		
4	24	0	250		

streptococci were found in some of the water samples indicates that mouth organisms can be transferred by means of a drink. The guard designed to protect the orifice from contamination may prevent direct mouth contamination but does not prevent indirect transmission of buccal streptococci and, undoubtedly, of other buccal organisms.

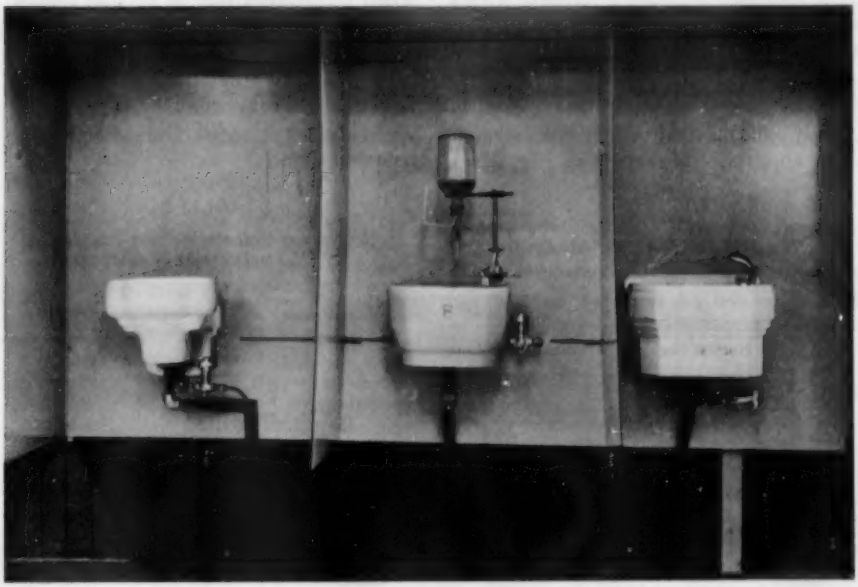

Fig. 1. Laboratory Fountain Test Setup

The apparatus over the center fountain was used to feed streptococci into the water stream in the same way as they would be fed during drinking. The partitions between the fountains are movable laterally.

Laboratory Fountain Tests

A study was made to determine the mode of contamination of drinking fountains. Three angle-jet fountains were installed in the laboratory for test purposes. The fountains differed in the dimension and shape of the bowl and the type of orifice and orifice guard. To determine the role of the bowl as a source of contamination of the water orifice, 10 ml of an 18-hr broth culture of *Streptococcus faecalis* was smeared over the bowl surfaces of the fountain after they had been carefully sanitized with a solution of sodium hypochlorite containing 200 ppm available chlorine. After the bowl of the fountain had been seeded, the water was turned on and allowed to flow continuously for 1-hr periods. Then swab samples were collected from the orifice and the orifice guard. Streptococci were found infrequently on the water orifice on two of the fountains examined, while the third

fountain showed no orifice contamination. The results indicate that the bowl surfaces are not the primary source of orifice contamination.

In a second attempt to find the source of orifice contamination, streptococci were fed into the stream of water in a manner simulating the act of drinking. A bottle equipped with a drip tube, containing a broth culture of *S. faecalis*, was inverted over the top of the stream of water from the fountain so that organisms could be slowly discharged into the stream. The apparatus is shown in Fig. 1.

TABLE 2

Recovery of S. faecalis *From Orifice*

Period of Fountain Operation *min*	Height of Stream					
	Normal	High	Low	Normal	High	Low
	Trial I			Trial II		
1	5	80	0	0	8	0
3	1	30	0	0	35	0
5	11	30	1	21	7	0
10	30	70	5	18	43	0
30	85	140	0	40	61	4
60	71	110	0	62	115	0
Controls	0	0	0	0	0	0

At the start of each experiment, the fountain was carefully sanitized, and control swabs were collected from the orifice. The fountain was operated intermittently, using a 10-sec flow period and a 5-sec rest period. The height of the stream was adjusted so that trials were made with normal, below-normal, and above-normal stream heights. Swab cultures were collected from the orifice at intervals of 1, 3, 5, 10, 30, and 60 min. The results are presented in Table 2.

These data show that the test organism was carried to the orifice by aerosol spread. When the stream of water fell into the bowl, splashing occurred and drops of water carrying the bacteria were disseminated. In one instance, the test organism was recovered from the orifice after 1 min of operation when the stream was at normal height. When the stream was above normal height, the number of organisms recovered from the orifice was high, whereas recovery was almost negligible when the height of the stream was below normal.

TABLE 3

Recovery of S. faecalis *From Partition (Normal Stream Height)*

Distance From Orifice to Partition *in.*	No. of Organisms per Swab	
	Trial I	Trial II
27	510	490
25	1,150	1,120
23	560	960
21	430	1,410
19	1,850	1,700
17	1,800	1,530
15	2,120	1,420
Controls	0	0

The next experiment was concerned with the spread by aerosol contamination to the area around the fountain. Partitions were installed in such a way that their distance from the fountain could be varied (see Fig. 1). A section about 36 sq in., directly in line with the stream coming from the orifice, was marked off on the partition. This section, as well as the water orifice, was sanitized before each experiment. The fountain was operated intermittently, as described in the previous study, for a period of 5 min.

Swab cultures were collected at the end of each period of operation. Again tests were made with the stream height at normal, below normal, and above normal.

The results, presented in Table 3, show that, when a normal stream height was used, large numbers of organisms were isolated from the partition area. The nearer the partition was to the fountain, the greater was the amount of contamination. As would be expected from the previous data, a stream below normal height gave less contamination and a stream above normal height yielded excessive numbers of organisms.

TABLE 4

Recovery of S. faecalis *From Aerosol Above Fountain*

Height of Agar Plate Above Fountain *in.*	Total No. of Organisms Recovered After 30 min
15	5
12	180
8	900
6	3,410
5	5,600
4	9,400
3	3,150
2	*
1	*

* Too numerous to count.

Agar plates were exposed for 10-sec periods at varying distances above the water streams to determine the extent of aerosol contamination outside the path of splashing drops. The results of these tests are presented in Table 4. An examination of these data shows that bacterial aerosols were formed as a result of the splashing of the contaminated water in the bowl of the fountain. Agar plates held at 1 and 2 in. above the stream of water developed so many colonies that counting was impossible. Apparently, large drops containing heavy populations adhered to the agar surface. This did not occur on plates held at higher levels. The even, heavy distribution of the colonies on the plates indicated that the air above the fountain was heavily contaminated with bacteria-containing aerosols.

Test on School Fountains

In the knowledge that the orifice and guard were subject to aerosol contamination, a drinking fountain used by the public was checked repeatedly during a day following complete sanitization. The fountain selected for study is located in a large school building, is near several classrooms, laboratories, and offices, and is frequently used throughout the day. The fountain is of modern design, with an angle jet and protective guard. The stream was at proper height and the drainage was rapid and complete. The fountain parts were thoroughly cleaned and sanitized, as previously described, early in

TABLE 5

Streptococci Recovered From School Fountain After Sanitization

Time After First Use *min*	No. of Streptococci		
	Bowl	Orifice	Guard
15	1,030	0	1
30	18	50	1
45	26	5	0
60	350	60	38
75	80	0	0
90	88	42	0
105	1,235	102	12
120	920	81	30
180	240	6	0
240	190	3	1

the morning. Swab samples collected from the bowl, orifice, and guard were negative following sanitization.

The orifice, guard, and bowl were swabbed at 15-min intervals, beginning 15 min after the fountain was first used. The swabbing was continued in this manner for 2 hr; then samples were collected at the end of the third and fourth hour. The swabs were examined as previously described, with results as shown in Table 5. The fountain became contaminated after use by one person. As no one was observed misusing the fountain, the bacteria isolated from the various areas of the fountain must have been rinsed from the lips and mouth of the user, so that the spread to the various areas of the fountain was due to aerosol contamination.

Conclusion

The results of these studies verify assertions by several early workers that drinking fountains may be a health hazard. It was demonstrated conclusively that the bubble type of drinking fountain is a reservoir for bacteria of buccal origin. As early as 1914 this fact was established by Berry (*1*); yet it is not an uncommon occurrence to find bubble fountains in schools, in factories, and on street corners. In the interest of public health, the authors recommend that the use of this type of drinking fountain be prohibited.

Summary

A survey of drinking fountains in public places revealed that insanitary conditions existed. Nearly 100 per cent of the fountains examined showed streptococci contamination of the bowl, orifice, and orifice guard. The bubble type of fountain proved to be the greatest offender, followed by the angle-jet fountain without a guard over the orifice.

Bacteria seeded into the stream of the drinking fountain were recovered from the bowl, the orifice, the orifice guard, walls adjacent to the fountain, and the air above it.

Drinking fountains in normal use were rapidly contaminated by bacteria washed from the lips and mouth of the users.

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High-Rate Filtration Experience at Durham

Wade G. Brown

A paper presented on Nov. 8, 1954, at the North Carolina Section Meeting, Asheville, N.C., by Wade G. Brown, Asst. Supt., Water & Sewer Dept., Durham, N.C.

KNOWLEDGE of the behavior of the so-called rapid sand filter is deficient. With the exception of the trend toward the use of coarser sand, the design of such filters has undergone little change since the beginning of this century. Therefore it seems worth while to present the experiences of Durham, N.C., with filtration rates higher than the usual 2 gpm per square foot.

George Warren Fuller, in a classic report (*1*) published in 1898, pointed out the necessity for coagulation and sedimentation prior to rapid sand filtration. Based on information obtained at Louisville, Ky., and later at Cincinnati, Ohio, Fuller and his associates designed filters for the East Jersey Water Co. at Little Falls, N.J., which were put in service in September 1902. The rapid sand filter as it is known today is a development and refinement of the Little Falls filters.

Among the many factors governing the proper and efficient filtration of water are the quality and temperature of the water; the efficiency of prefiltration treatment (coagulation and sedimentation); the filtration rate; and the type, effective size, and uniformity coefficient of the filter medium. The earliest theory of filtration phenomena held that the straining action took place almost entirely at the filter medium-water interface, with the strained out substances forming a jellylike mat ("schmutzdecke") on the surface of the filter. It is now generally recognized that the straining effect is not confined to the surface of the filter but is present throughout the whole body of the filter medium. It has been suggested that sedimentation and flocculation also occur within the body of the filter.

Using radioactive iron floc, Stanley (*2*) found the following relationships to be true for the reaction of floc to uniform beds of sand:

1. The depth of penetration varies directly with the concentration of iron per unit surface area of the filter bed; the ratio of depth of penetration to degree of surface loading is a suitable "index of penetration."

2. This ratio becomes larger as the floc concentration, rate of flow, or sand size is increased.

3. The ratio also becomes larger when electrolytes, such as sodium chloride, sodium sulfate, and magnesium sulfate, are added to the applied water.

4. The ratio becomes smaller as the floc is increased in size or aged.

5. The ratio varies with the pH of the applied water, reaching a minimum as the neutral point (pH 7.0) is approached.

Stanley's valuable work gives further emphasis to the fact, first reported by Fuller, that treatment of water prior to filtration is the most important key to efficient and economical operation.

Experimentation with high-rate filtration (more than 2 gpm per square foot) is going on at many water treatment plants in the United States, primarily because increased construction costs have made it important to produce safe and satisfactory water by the most economical means possible. Although the savings in plant construction and operating costs will obviously vary widely according to the local situation, Baylis—who has stated (*3*) that "filtration rate practice is still in the nineteenth century"—estimates that Chicago could save 5 per cent in construction cost and perhaps 2–5 per cent in operation and maintenance expense by designing for 3 gpm per square foot instead of 2 gpm (*3, 4*).

A study of the available literature, together with visits to several treatment plants filtering water at high rates, convinced the author that a carefully controlled investigation into the possibilities of high-rate filtration should be initiated at Durham, N.C. Plans were under way in 1948 for an addition to that city's filtration plant, but the only change in filter design, for the purpose of the proposed experiments, was to increase the effective size of the sand slightly. The State Board of Health was asked to permit the operation of one new filter at 4 gpm per square foot, another at 3 gpm, and a third at 2 gpm, to act as a control. Permission was granted for operation in this manner during a period of not less than 2 years, with the understanding that complete data would be furnished to the board when the experiment was concluded.

Durham Plant Design

Owing to the importance of thorough prefiltration treatment of the water, certain plant design data are necessary for a proper appraisal of the success of high-rate filtration at Durham. Three filters, each having 480 sq ft of surface area, were used in this investigation. The mixing, flocculating, and sedimentation units designed to feed them are described below.

The flash mix chamber, which provides for the efficient and instantaneous dispersal of alum and lime after prechlorination to a free available residual, has a nominal retention period of 3 min at 8 mgd. Either mechanical agitation or high-rate diffused air is employed. The flocculating chamber has four vertically mounted paddle flocculators with a variable-speed drive. Variable-intensity diffused-air flocculation is also provided. The nominal retention period is 21 min at 8 mgd.

A concrete flume conducts the flocculated water to the sedimentation basins; at a rate of 8 mgd, the velocity in the flume is 0.92 fps. Two 12-in. cast-iron pipes pass the flocculated water from the flume into each of four sedimentation basins; at 8 mgd, the velocity through each pipe is 1.96 fps.

The sedimentation basins are of unusual design. The influent end of each basin consists of three sections with hopper bottoms, 20 ft in depth, exclusive of the hoppers. The flocculated water is discharged above the hopper of the first section; flows over a 12-ft baffle into the second hopper section and under a 14-ft curtain baffle through a 6-ft aperture into the third hopper section; from there it flows into a shal-

low secondary sedimentation area of more conventional design. The depth of the shallow section is 15 ft at the influent end and 14 ft 7 in. at the effluent end. The nominal retention time of each of the four separate basins is 3:56 hr at 8 mgd. The settled water passes up from the basin to a concrete flume into which the filter influent piping is set. The flume is so valved that any combination of filters and basins may be used.

This design provides a valuable advantage in that the deep hopper section acts to exert a continuing flocculation effect, increasing greatly the effectiveness of both flocculation and sedimentation. The flexibility provided by the effluent flume has also proved invaluable, not only in experimental work but in plant operation.

The sedimentation basins are self-cleaning; practically all of the floc settles in the hopper sections, equipped with drains through which the accumulated sludge is flushed daily. The entire basin is emptied and hosed down periodically, the frequency depending upon the load imposed. At a rate of 2 gpm per square foot, such cleaning has usually been necessary only once a year. With rates of 3–4 gpm, it is necessary to dewater and hose down the basins two or three times a year.

Except for the underdrain system, the 12 × 20-ft filters are of standard design. Because they are constructed in pairs, with common influent, effluent, wash water, and control facilities, it is plant custom to regard each pair as a single filter; thus, when reference is made to filter No. 12, for example, it will be understood that this designates two filters, with a combined surface area of 480 sq ft. The underdrains are constructed of perforated concrete slabs with 2-in. long, 0.2075-in. ID glass tubes spaced 4 in. apart, center to center.

The filter sand has a mean effective size of 0.55 mm, a uniformity coefficient of 1.4–1.8, and a depth of 25 in. Below this is a 4-in. layer of coarse sand, which tops four layers of graded gravel ($\frac{3}{16}$–$2\frac{1}{2}$-in. screen size) with a total depth of 16 in.

Filter Tests

The new filters were placed in service in June 1950. On Nov. 1, after several months devoted to preliminary experimentation and operation, Filter No. 12 (the control) was set to operate at 2 gpm per square foot, No. 13 at 3 gpm, and No. 14 at 4 gpm. This scheme of operation continued until Oct. 31, 1953. During the entire 3-year period no special or additional treatment was given the water entering the high-rate filters.

It will be recalled that a common flume was provided, so that any or all of the sedimentation basins could supply any filter or combination of filters; by means of gates, each basin could be made to feed a specific filter. At the beginning of the experimental period the flume was left open, so that the high-rate filters could draw from more than one sedimentation basin if necessary. After the initial trial had proved satisfactory, the basins and filters were isolated, and an individual basin was required to feed a single filter. This trial was also successful, and only slight reductions in filter runs were observed, even at the highest rate.

Daily chemical, physical, bacteriological, and operational data and test results were compiled for the two high-rate filters and the control. The detailed records are on file with the State

Board of Health. A summary of the more important results is presented in Table 1. The differences in the quality of the effluents from the various filters are so slight as to have no significance. The differences in the length of filter runs and the percentage of wash water bear out the experience of other investigators (*3, 4*). Filter No. 12 averaged 135.2 hr per run, with a minimum of 44 and a maximum of 187 hr; No. 13 averaged 116.7 hr, with a minimum of 45 and a maximum of 186 hr; and Filter No. 14 averaged 81.3 hr, with a minimum of 33 and a maximum of 164 hr. Filter No. 13 (3 gpm) showed the greatest economy of wash water, using only 0.89 per cent. This corroborates a recommendation by Baylis (*4*) that all filtration plants should be designed with a minimum of 3 gpm per square foot as the standard rate.

TABLE 1

*Summary of Test Results**

Item	Filter No.		
	12 (2 gpm)	13 (3 gpm)	14 (4 gpm)
Length of run—*hr*	135.2	116.7	81.3
Wash water—*per cent*	1.21	0.89	0.99
Turbidity—*ppm*	0.34	0.38	0.43
Bacteria—*colonies/ml*	0.32	0.42	0.36
Coliform organisms	negative	negative	negative

* The total amount of water passing through the individual filters during the 3-year test period is not known, as they were unmetered. It may be assumed, however, that the quantities were proportional to the rates, as the accuracy of the standard venturi controllers was checked before and during the tests. The filters were operated continuously during the trial period, except when being washed.

These results are all on the credit side of the ledger. It should be noted, however, that any deterioration in the quality of the water applied to a filter at high rates will be reflected in a poorer quality effluent more quickly and, of course, in much greater volume than at standard (2-gpm) rates. This means that greater vigilance and very careful control of chemical dosing and flocculation must be exercised by competent personnel. In the author's opinion, if responsible authorities are not prepared to provide the proper type of supervision and control, filtration at rates greater than 2 gpm per square foot should not be attempted or permitted.

It is also obvious that, with high-rate filtration, mechanical equipment must be especially accurate and dependable, and that the plant itself must be so designed that efficient flocculation and sedimentation can be obtained. In this connection, the question of what constitutes adequate design for proper prefiltration treatment of raw water should be examined most carefully. It is well recognized that the prefiltration treatment of raw waters varies greatly; what is adequate and proper design for one water may be gross over- or under-design for another. Water treatment personnel in this country are an alert and well trained group; consulting engineers would do well to work closely with these men in evaluating their treatment problems.

Summary and Conclusions

A brief introduction and background was presented on the subject of water filtration. It was emphasized that there has been little change in the design of filters for the past 50 years and that, for reasons of economy alone, this matter deserves further study and development. The importance of the proper type and degree of prefiltration treatment was also stressed, and the need for a careful study of the raw

water as a preliminary to plant design was underlined.

Beginning in 1950 Durham operated newly constructed filters at rates of 2, 3, and 4 gpm per square foot for 3 years. The tests were carefully and minutely controlled, and the results thoroughly documented. No significant difference in water quality was found among the effluents from the three filters under test. The percentage of wash water required was appreciably less for the filters operating at the high rates. The Durham plant is so designed and constructed that no increase in chemical dosage or in length of flocculation and sedimentation periods was required for the filters operating at the higher rates.

Under the conditions prevailing at the Durham Water Filtration Plant—water quality amenable to necessary treatment, good mechanical equipment, adequate plant design, careful and competent plant supervision and control—filtration at rates of 3 and 4 gpm per square foot has proved safe and satisfactory in every way, and of very considerable economic advantage.

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Effect of Downstream Throttling on Venturi Tube Discharge

Andre L. Jorissen

A contribution to the Journal by Andre L. Jorissen, Head, Dept. of Hydraulics & Hydraulic Eng., School of Civ. Eng., Cornell Univ., Ithaca, N.Y.

IT has long been known that valves can be attached directly to the outlet of venturi tubes and that, in this position, they will not affect the accuracy of measurement, even when used for throttling. This fact gives venturi tubes a definite advantage over flowmeters, which are affected by downstream throttling. All of the available straight pipe can be upstream from a venturi tube, thereby providing higher accuracy in limited pipe runs than can be obtained with shorter metering devices.

It has been customary for manufacturers of the venturi type of rate-of-flow controllers used in filter effluent service to locate the control valves within the diffuser section of the venturi tube. Such controllers are usually offered with only slightly wider accuracy tolerances than those of venturi tubes, and the valves do not affect the accuracy beyond these tolerances.

There is frequently a decided economic advantage in locating throttling valves in the diffusers of venturi tubes. With certain types of valves in common use, costing about $300 per inch of pipe diameter, large savings can be made by using valves smaller than line size and placing them close to the throat of the tube. Valves do not come in an even progression of sizes, but in steps. Considerable economy could frequently be achieved if it were possible to use a valve just a trifle smaller than the size recommended by the manufacturer. For instance, with a 30 × 15-in. short-form venturi tube, the manufacturer would normally recommend that a valve used for throttling service should not be smaller than 20.6 in. This means that a 24-in. valve must be used. If the valve could be installed a little closer to the throat, a 20-in. size, costing approximately $1,200 less than the 24-in., would be practicable.

Experimental Study

A series of tests has been made in the Hydraulic Lab. at Cornell University, Ithaca, N.Y., to determine: [1] the minimum distance from the throat of a standard Herschel type venturi tube at which a gate valve can be located without affecting the accuracy of the meter; [2] the amount of throttling that can be done at various locations before the venturi tube coefficient exhibits a measurable change; and [3] the amount of error resulting when a valve is located so close to the throat that the coefficient is changed.

An 8 × 4-in. Herschel type venturi tube was used in the experiments. It was placed in an 8-in. steel pipeline in good condition. The static head on the arrangement was 80 ft. The

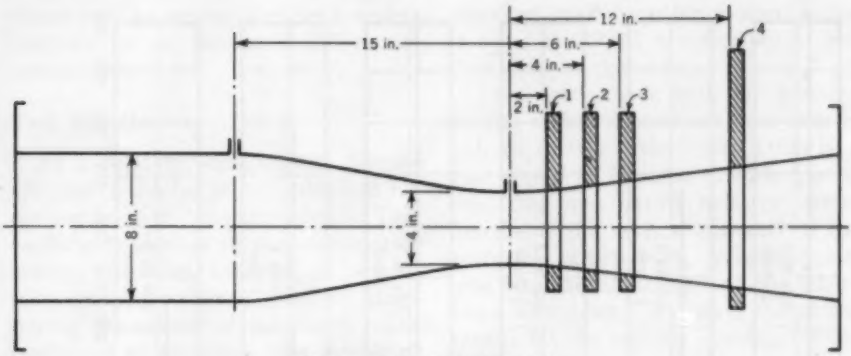

Fig. 1. Test Arrangement

Four plywood gates (numbered 1–4) are located at various distances downstream from the throat of the venturi tube. The distances are measured from the throat pressure connection.

straight approach section to the venturi tube was 18 ft long, equivalent to 27 pipe diameters. Figure 1 shows the setup of the venturi tube and valves. The converging cone and throat section of the tube are of standard design, but provision was made for the insertion of plywood gates at four locations downstream from the throat section. Each gate has a circular opening that fits the bore of the diverging cone of the venturi tube when the gate is lowered into position. The gates were located 2, 4, 6, and 12 in. downstream from the throat pressure connection and were numbered 1, 2, 3, and 4, respectively.

Eight sets of test runs were made, using the different gates and various openings for each. Each test run was conducted under controlled conditions, with observations being made at 40–45 different rates of flow. The flow rate of water passing through the venturi tube in each test was carefully measured by means of a volumetric tank of 600-cu ft capacity, provided with a suitable diverter and an electric timing device. The differential head produced in the tube during each test was

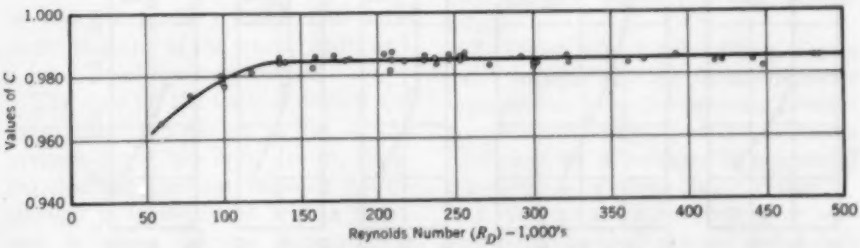

Fig. 2. Data on Basic Condition (All Gates Open)

A constant value for the discharge coefficient is obtained at Reynolds numbers exceeding 140,000.

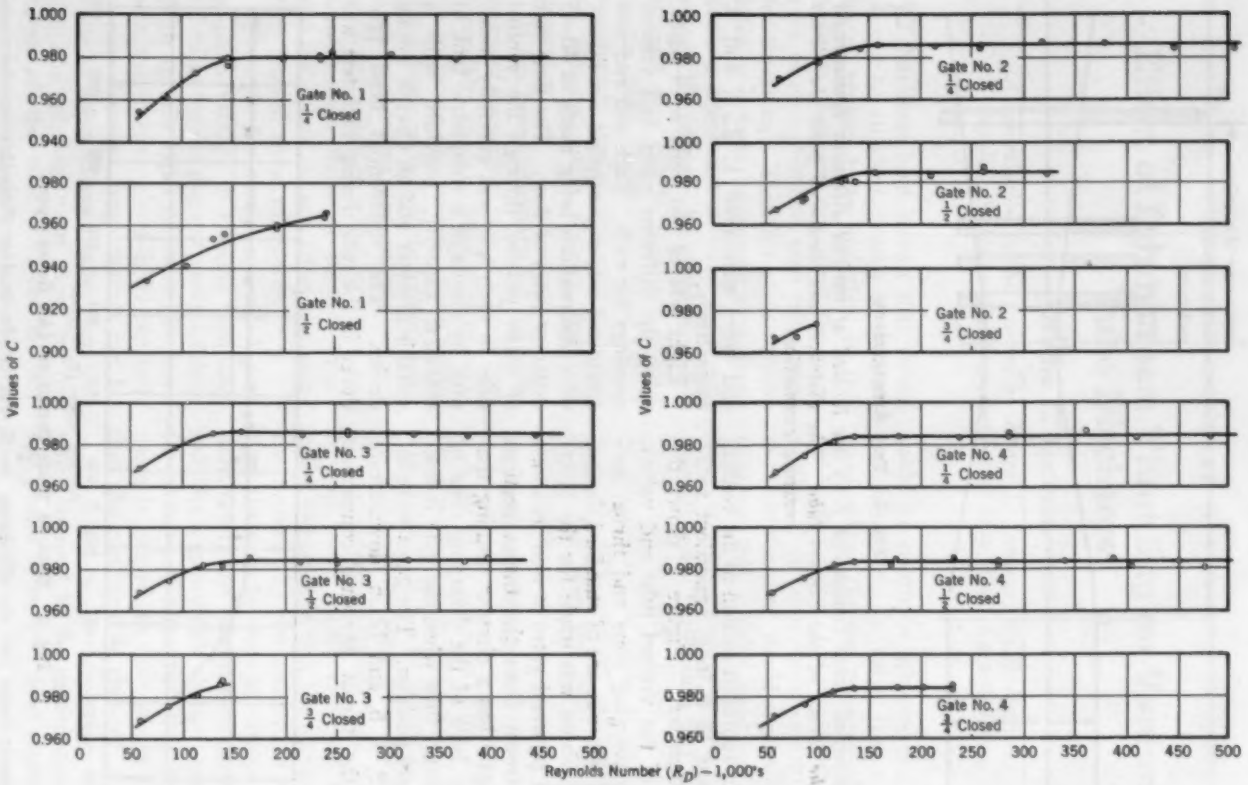
Values of C
Gate No. 1 1/4 Closed
Gate No. 1 1/2 Closed
Gate No. 3 1/4 Closed
Gate No. 3 1/2 Closed
Gate No. 3 3/4 Closed
Gate No. 2 1/4 Closed
Gate No. 2 1/2 Closed
Gate No. 2 3/4 Closed
Gate No. 4 1/4 Closed
Gate No. 4 1/2 Closed
Gate No. 4 3/4 Closed
Reynolds Number (R_D)—1,000's

Fig. 3. Results of Tests

These findings are summarized in Table 1.

determined by means of either a water-mercury or an air-water differential manometer.

Test Results

As a basis for comparison, the coefficient of discharge was obtained for the condition of "all gates open." This coefficient, as used in the comparative studies, was an average of several measurements taken at various times during the course of the study. The coefficient of discharge was calculated from the formula:

$$q_v = \frac{Ca}{\sqrt{1-\beta^4}}\sqrt{2gh}$$

in which q_v is the volumetric rate of flow (cfs); C is the coefficient of discharge; $a = \frac{\pi d^2}{4}$ is the throat area (sq ft); d is the throat diameter (ft); D is the pipe diameter (ft); $\beta = \frac{d}{D}$ is the diameter ratio; g is the acceleration of gravity (fps/sec); and h is the differential head (ft).

The coefficient of discharge was plotted as a function of the pipe Reynolds number, $\mathbf{R_D}$:

$$\mathbf{R_D} = \frac{4q_v}{\pi D\nu}$$

in which ν is the coefficient of kinematic viscosity of the water (sq ft/sec), a function of the temperature.

The data on the basic condition (all gates open) are plotted in Fig. 2. An average curve has been drawn, showing that the constant value of the coefficient is $C_e = 0.9849$, with a standard deviation of one measurement equal to 0.15 per cent. This value is obtained for Reynolds numbers larger than 140,000. The corresponding standard coefficient for venturi tubes is equal to 0.9840, a difference of less than 0.1 per cent (*1*).

Tests were made with the gates in several different positions—one-fourth, half, or three-fourths closed (that is, a gate would be lowered to such a position that one-fourth, half, or three-fourths of the vertical diameter of the valve was obstructed). Whenever one gate was partially closed, all the others were wide open. Figure 3 shows the results for the various openings of the different gates.

Sufficient head was not available to obtain a flow corresponding to a constant value of the coefficient of discharge with Gate No. 1 throttled to the half-closed position. Likewise, sufficient head was not available to study gates No. 2–4 at closures greater than those indicated in Table 1.

Conclusions

These studies were made on a venturi tube half the diameter of the pipeline (that is, a diameter ratio of 0.5), but the conclusions drawn from the tests probably are applicable to venturi tubes with other diameter ratios:

1. When not used for throttling, a valve can be located as close as half the throat diameter downstream from the throat pressure connection without affecting the accuracy of the venturi tube.

2. When used for throttling, a gate valve located half the throat diameter downstream from the pressure connection will adversely affect the discharge coefficient by a measurable amount if the valve is only one-fourth closed.

3. When used for throttling at one-fourth and one-half closure, gate valves located at points 1, 1½, and 3 throat diameters downstream from the throat pressure connection have practically no

TABLE 1

Summary of Experimental Data

Gate Closed	Distance From Throat Pressure Connection *throat diam.*	Degree of Closure	C_e	Variation From C_e With All Gates Open *per cent*	$(R_D)_m$*
No. 1	½	¼	0.9802	−0.48	160,000
No. 2	1	¼	0.9848	−0.01	150,000
		½	0.9851	+0.02	160,000
No. 3	1½	¼	0.9854	+0.05	150,000
		½	0.9848	−0.01	160,000
No. 4	3	¼	0.9845	−0.03	140,000
		½	0.9839	−0.10	140,000
		¾	0.9842	−0.07	140,000

* Minimum value at which coefficient becomes constant.

effect on the accuracy of the venturi tube. The changes in coefficient of discharge are small and of the order of magnitude of the experimental errors. When Gate No. 4 (3 throat diameters downstream) was three-fourths closed, its effect was still within the limits of experimental error.

4. It seems well established that for the particular diameter ratio considered (0.5), the following maximum amounts of diameter throttling are safe for gate valves located at the indicated distances from the throat pressure connection:

Location *throat diam.*	Closure *per cent*
½	25
1	50
1½	50
3	75

5. The limits of constancy for the Reynolds number are only slightly different in the various cases, ranging from 160,000 for Gate No. 1 to 140,000 for Gate No. 4.

6. The error caused by throttling, when the valve is one-fourth closed and half a throat diameter from the throat vent, is about 0.5 per cent with the meter reading high. It may be assumed that further throttling at this location will increase the error.

Acknowledgment

These experimental studies were made as part of a research project sponsored by Builders-Providence, Inc., Providence, R.I., which has graciously granted permission for the author to publish these results.

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Flame Spectrophotometric Determination of Calcium in Potable Water Supplies

E. G. Will and Blanche Schwarzkopf

A contribution to the Journal by E. G. Will, Chief Chemist, and Blanche Schwarzkopf, Chemist, Div. of Labs., State Dept. of Health, Columbus, Ohio.

A STUDY initiated in order to develop a rapid and accurate method for the determination of calcium in potable water supplies indicated that the flame spectrophotometric determination of calcium in the presence of excess sulfate ions met this objective. The percentage transmittance was measured at 554 mμ, which is the wavelength of a strong calcium oxide band. Calcium, in the presence of interfering ions found in drinking water, does not give a linear curve. The results, however, show a uniform, reproducible curve easily read, without the necessity for corrections for blank or flame background. Water samples containing small amounts of calcium may be quickly analyzed with accuracy comparable to slower and more cumbersome methods.

It is a well known fact that various ions, both cations and anions, affect the intensity of the characteristic calcium flame emission. Probably the only generalizations regarding these interferences are that both their direction and their magnitude depend to some extent upon the instrument used and that the interferences are minimized at high dilutions. The quantitative effects of these ions have been investigated by many workers (*1–3*). The interfering ions are often added in known or excess amounts and curves set up accordingly.

Water samples received from different areas may vary from less than 100 to more than 1,500 ppm hardness. Such samples also contain many interfering ions in the form of bicarbonates, silicates, fluorides, phosphates, sulfates, iron, magnesium, and manganese. These interferences are present in varying proportions, making it impossible to set up a so-called normal water.

TABLE 1

Effect of Interferences

Interference Added to 50-ppm Ca and Acid Solution	Calcium Recovered *ppm*
—	50
100 ppm Na	49
100 ppm K	50
100 ppm Mg	50
100 ppm (each) Na, K, Mg	52

Because the sulfate ion is a strong radical that usually occurs in water supplies, it was selected to eliminate these interfering substances. It was found that the excess sulfuric acid stabilized not only the anions but also the cations, allowing the calcium to be accurately determined. By using known amounts of calcium and adding the acid, the reproduction of the flame photometric readings was within ±2 per cent transmittance. This variation

was due partially to fluctuation of the flame.

This paper presents a satisfactory method for the determination of small amounts of calcium found in potable waters.

Experimental Procedure

The instrument used for the tests described was a Beckman DU spectrophotometer, equipped with a Model 9200 flame photometry attachment and a photomultiplier tube.* Hydrogen was used as the source of fuel.

The wavelength setting was 554 mμ; selector, 0.1; slit width, 0.34 mm; oxygen pressure, 10 psi; hydrogen pressure, 5 psi. These settings gave the best results for the instrument used. A curve was set up with 100 ppm calcium (Ca) to read 100 per cent transmittance. Samples containing more than 100 ppm calcium require an aliquot. Frequent checking and adjusting of the sensitivity control were done to assure uniform readings throughout the range tested.

A standard stock calcium chloride solution was made by dissolving 2.509 g of calcite in hydrochloric acid and diluting to a liter with distilled water. One hundred milliliters of this solution was diluted to a liter to give a 100-ppm standard. From the latter, a series of dilutions was prepared, containing 75, 50, 25, 10, and 0 ppm Ca. To 100 ml of each of these, 4 drops of 20 per cent sulfuric acid was added and the solution mixed well. This amount of acid, at the given strength, added to 100 ml of solution results approximately in a 0.007*M* acid solution. When the instrument was adjusted to read 100 per cent transmittance with the acidified 100-ppm calcium standard, it was found that the various dilutions fell into their proper places on the working curve, as shown in Fig. 1.

TABLE 2

Percentage Calcium Recovery

Sample No.	Amount Ca Added *ppm*	Amount Ca Recovered (No Acid Added)		Amount Ca Recovered (Acid Added)	
		ppm	*per cent*	*ppm*	*per cent*
1	5	5.0	100	4.5	90
2	15	15.0	100	15.0	100
3	30	31.0	103	29.0	97
4	50	49.5	99	50.0	100
5	55	54.5	99	55.0	100
6	75	74.5	99	74.0	99
7	95	95.0	100	93.0	98

Results of Tests

In order to evaluate the effect of certain cations on the calcium emission, 100 ppm sodium, 100 ppm potassium, and 100 ppm magnesium were added separately to portions of a 50-ppm calcium solution to which sulfuric acid had been added. Also, to one portion of a 50-ppm calcium solution were added 100 ppm each of sodium, potassium, and magnesium. Photometer

* The equipment mentioned is made by Beckman Instruments, Inc., South Pasadena, Calif.

readings were then taken at the 554-mμ wavelength. The results in Table 1 indicate that these interfering ions, in amounts up to 100 ppm, have no effect on the calcium oxide diatomic emission.

In order to ascertain the percentage recovery, known amounts of calcium were added to distilled water, and the emission was compared with a standard calcium curve. This procedure was repeated after the addition of sulfuric acid and compared with the curve made from acid calcium standards. As

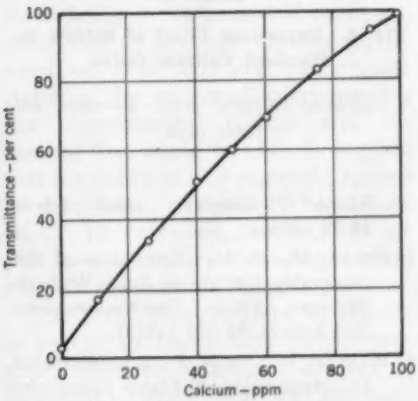

Fig. 1. Acid Working Curve

When the photometer is adjusted to read 100 per cent transmittance with the acidified 100-ppm calcium standard, the various dilutions fall into their proper places on the curve.

is shown in Table 2, there was almost 100 per cent recovery.

Table 3 compares the results of calcium determinations by the acid-flame and usual chemical methods. Routine water samples with varying concentrations of the interfering substances were analyzed by the two methods. The comparison indicates that the flame spectrophotometer can be successfully used in the determination of calcium in potable waters. Its accuracy compares favorably with that of the very much slower methods in vogue today.

The procedure of adding an excess of sulfate ions diminished the flame intensities, but eventually a point was reached at which further additions produced no effect (Fig. 2). This finding is in accord with the results of Baker and Johnson (*4*), which showed that, in the presence of excess sulfuric acid, the effect of other anions was nullified and a definite plateau was established. It has been theorized that ionization occurs in the flame and that an intermediate or, perhaps, a stable pyrosulfate is formed, together with the oxide, in definite proportions. Such action would indicate that the depressant effect is the result of fewer calcium ions in an excited state and that only those combined as the oxide are read at a particular wavelength. Figure 3 shows the depressant effect of the sulfate ions on the standard calcium curve.

TABLE 3

Comparison of Acid Flame and Chemical Methods

Sample No.	Calcium Determination—*ppm*	
	Flame	Chemical
1	34	33
2	28	27
3	58	58
4	42	40
5	98	97
6	49	49
7	89	91
8	4	3

Conclusion

Small quantities of calcium can easily be determined by the flame spec-

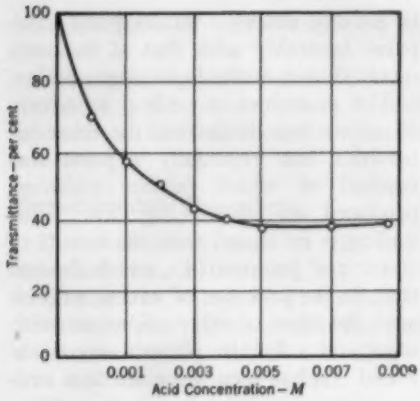

Fig. 2. Effect of Excess Sulfate

As the acid concentration is increased, a plateau is eventually reached.

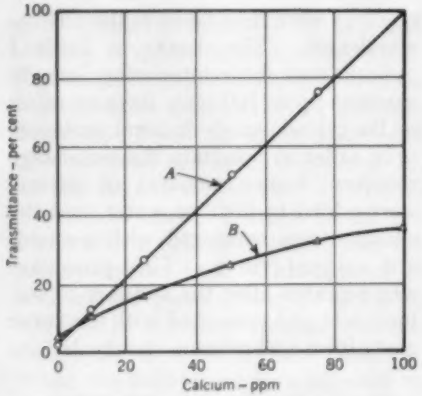

Fig. 3. Depressant Effect of Sulfate on Standard Calcium Curve

A—*without sulfuric acid;* B—*with sulfuric acid.*

trophotometric method described. Reliable and reproducible results can be obtained with the necessary accuracy to warrant application of the method to routine water analysis. (Sensitivity can be increased tenfold by opening the slit until a reading of 100 per cent transmittance is obtained with 10 ppm calcium; thus, a sensitivity of 0.1 ppm may be reached.) Small quantities of sample are sufficient, and only the addition of sulfuric acid is required.

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West Virginia Fluoridation Control Tests

H. K. Gidley and John H. Millar

A paper presented on Nov. 8, 1954, at the West Virginia Section Meeting, Huntington, W.Va., by H. K. Gidley, Director, and John H. Millar, Engr.; both from Div. of San. Eng., State Dept. of Health, Charleston, W.Va.

ONE argument frequently presented by opponents of water fluoridation is the hazard of overtreatment due to defective feeding equipment or plant operator carelessness. Actually, the margin of safety between the recommended dosage and the amount that would be toxic is so great that the public is well protected against a dangerous mishap. The record should be examined, however, to see just how accurately the average plant controls the fluoride dosage.

The West Virginia Dept. of Health, as part of its fluoridation control program, routinely examines samples of fluoridated water sent in by local health departments. To provide an independent check, the samples are normally submitted without being referred to the water utility concerned. Samples from new fluoridation installations are examined weekly at first. After establishment of a satisfactory record of performance, a semimonthly sampling interval is adopted. As the number of installations increases (there were 23 in October 1954) the laboratory load will become heavier, so that state health department sampling may have to be reduced to one per month.

Sampling Results

Samples are mailed to the State Hygienic Lab. in standard bacteriological water sample bottles, which have been rinsed to eliminate the sodium thiosulfate dechlorinating agent. The Bureau of Industrial Hygiene Lab. of the state health department makes the fluoride determinations.

A study has been made of all fluoridation control samples submitted to the West Virginia Dept. of Health for the year beginning Jul. 1, 1953. At the start of the period there were eight fluoridation installations in the state, but the number had increased to eighteen by Jun. 30, 1954. During the 12-month period a total of 242 control samples were received by the department. Of this number 23 were not suitable for examination, or else interferences prevented an accurate determination. The results of the remaining 219 analyses are shown in Table 1.

The state health department has established the permissible fluoride dosage in the water plant effluent at an average of 1 ppm F, with a range of 0.8–1.3 ppm. A total of 86.3 per cent of the samples were in the proper range, 10.5 per cent of the samples were underdosed, and 3.2 per cent were overtreated.

Underdosage can usually be accounted for either by mechanical failure of equipment, resulting in a stoppage or reduction of the feed, or by a temporary depletion of the chemical.

Seven of the 219 samples contained more fluoride than the recommended maximum of 1.3 ppm, but 1.6 ppm was the highest amount recorded. An occasional sample at this level is not of public health significance. Intermittent difficulty with overtreatment at one installation in West Virginia has been due to sudden increases of fluoride content in the raw river water as a result of industrial-waste discharge. Because of interference with the raw-water fluoride test, the plant operator has at times been unable to reduce the feed rate quickly enough to prevent overdosage.

It should be noted that ten of the eighteen fluoridation installations represented by the samples had only recently been placed in operation. Some of the samples were collected during the trial periods at these plants, when variation in treatment is not uncommon.

Summary and Conclusions

Tests of 219 samples collected during a year from eighteen public water supply fluoridation installations have been studied to determine the variation in treatment to be expected in normal operation. Of these samples, 86.3 per cent fell within the 0.8–1.3-ppm F range approved by the state health department; 10.5 per cent were undertreated and 3.2 per cent were overtreated. The maximum fluoride content recorded was 1.6 ppm, somewhat above the recommended level for continuous treatment. This overdosage is of no public health significance when it occurs only in an occasional sample.

West Virginia has had practical experience with eighteen fluoridation installations representing large and small water works with many variations in feeding equipment and capabilities of personnel. Results support the position of public health and water supply officials that, from an operational standpoint, fluoridation is a safe, practical procedure.

TABLE 1

Fluoride Content of Water Supplies

Fluoride Content *ppm* (F)	No. of Samples	Per Cent of Total Samples
0.2	1	0.5
0.3	0	0.0
0.4	1	0.5
0.5	4	1.8
0.6	6	2.7
0.7	11	5.0
0.8	21	9.6
0.9	34	15.5
1.0	59	26.9
1.1	41	18.7
1.2	24	11.0
1.3	10	4.6
1.4	4	1.8
1.5	2	0.9
1.6	1	0.5
	219	100.0

Commercial Records for Small Water Systems

W. Francis Gordon

A paper presented on Nov. 4, 1954, at the New Jersey Section Meeting, Atlantic City, N.J., by W. Francis Gordon, Comptroller, New Jersey Div., American Water Works Service Co., Palmyra, N.J.

THE customer-accounting division might well be regarded as the heart of any water utility. On its efficient operation depends the flow of that life-giving substance, commonly called "cash," that is so essential to a successful business. It is particularly important for the small water system, where the gross revenue received in a year is probably less than that of the corner grocery store.

In adopting commercial records for a small water system—serving up to 10,000 people or 2,500 customers—the first consideration should be simplicity, because the office personnel will probably consist of one girl, who must be office manager, cashier, bookkeeper, and file clerk, to name only a few of the many jobs that she will be asked to do. On the other hand, the records must be inclusive enough to meet the requirements of regulatory boards, tax bureaus, stockholders, or other interested parties. This discussion will be limited to four basic types of records that are necessary for a successful system of customer accounting: [1] the service record, [2] the meter book or flat-rate fixture survey book, [3] the customer's bill and ledger card, and [4] the route control ledger.

Service Record

The service record is used in taking an application for water service. It should provide space for the name and address of the applicant, the date of application, the date service is to be turned on, the account number, the size of the meter installation, the meter number, and the meter reading at the time of installation. Provision should also be made for posting to show that an addressograph plate and a meter-reading sheet or flat-rate fixture survey sheet have been prepared.

The author's organization has developed an all-purpose form, called a "daily work order," for the small water system. This form (Fig. 1) is used for every type of job, from a service line installation to the investigation of excessive consumption. It contains space for listing not only the information previously cited but also the amount of labor and material used on each job. This information is used to advantage in preparing the weekly or biweekly payroll and the monthly report of materials issued from stock.

Meter Book

The meter book is the up-to-date history of the customer's account. For this reason, the author believes that the meter-reading sheets should be of sufficient size to accommodate quarterly readings for approximately a 6-year period. Columns should be provided not only for the date of reading, the meter registration, and the consump-

COMPANY WORK ORDER NO.

ACCOUNT NAME ACCOUNT NO. Dated

Location Town

WORK TO BE DONE:

- ☐ Turn on—Install Meter
- ☐ Turn off—Remove Meter
- ☐ Change Meter
- ☐ Investigate High Consumption
- ☐ Investigate Slack Pressure
- ☐ Investigate Leak at Curb—In Street
- ☐ Investigate Leak at Meter
- ☐ Install—Renew—Service

WORK DONE AND INFORMATION:

Account Name Changed to:

Mail Bill to:

New Owner—Tenant:

Work Requested by:

Key From

Street Permit No. Date Cost

Type Paving Size Opening

Turned on at Curb At Meter

Turned off at Curb At Meter

Meter No. Installed Reading Gal.

Meter No. Removed Reading Gal.

Work Started A.M.—P.M.

Work Completed A.M.—P.M.

New Work — Renewal — Repairs — Changes

Meter Reading:

Units	Size	MATERIAL USED	Unit Cost	Total Cost
		Copperhorn		
		Coppersetter		
		Barrel and Top		
		Copper Service Pipe		
		Galv. W. I. Pipe		
		Cast Iron Pipe		
		Galv. W. I. Nipple		
		Stop and Waste		
		Ell		
		Service Ell		
		Union		
		Tee		
		Extension Piece		
		Socket		
		Service Clamp		
		Corporation		
		Eighth Bend Connection		
		Curb Cock		
		Coupling—Copper to Copper		
		Coupling—Copper to Iron		
Charge Acct. No.		Total		

Signed

TIME — NAME	Hours	Rate	Total	Posted
				Ledger
				Meter Book
				Address Plate
				History Card
				Record Map
				Mat'l Credit
				Total Labor
				Total Mat'l
				Total Charge
				Acct. No.
				Acct. No.
				Consumer
Charge Acct. No.				

Use Other Side for Sketch and Other Information

Fig. 1. Daily Work Order

The actual size of the form is 8½ × 11 in.

tion but also for remarks and the amount of billing (Fig. 2). It may appear that listing the amount of billing on the meter sheets is a duplication of work, but the advantages more than compensate for the small additional effort, because the investigation of customer complaints, the prepara-

tion of average bills where meter readings cannot be obtained, and other analyses that may become necessary from time to time are all facilitated.

Good use can also be made of the space for "Remarks." When the meterman cannot obtain a reading, it is sometimes advisable to leave a self-addressed, stamped postcard on which the customer may insert the reading. In such instances, a notation to that effect may be made in the meter-reading book. This space is also useful for noting any unusual consumption or leakage that may result in an abnormally high water bill. The author has found that this type of information greatly aids the office clerk in the preparation of bills.

The postcard left at homes where readings cannot be obtained is preprinted with a dial face, if that type of meter is used. The customer indicates the position of the dial hands on the card and sends it to the utility office. Water systems with meters that show the registration figures in a straight line may use cards with blank blocks, in which the customer can insert the numerals appearing on the meter (Fig. 3). Generally a time limit of 3 days is allowed for the customer to return the card.

Flat-Rate Ledger

In systems without meters, billing is usually based on the number of fixtures found in the home. For this type of billing it is necessary to use a flat-rate fixture survey ledger in lieu of a meter book. This form (Fig. 4) provides for a listing of the different kinds of fixtures and the rate applicable to each. Space is usually included for the listing of additional fixtures that may be found in future surveys, thus eliminating the need for preparing a new ledger sheet every time a fixture survey is made. Here again, the author believes it essential to provide space for recording the amount billed during each period.

Customer's Bill and Ledger Card

The customer's bill and ledger card to be described, often termed the "three-part bill," is particularly adaptable to postcard billing. The trend over the past two decades has been toward this type of billing, which provides ease of handling and saves postage. The three parts of the bill are the customer's bill, the cashier's stub, and the ledger card (Fig. 5).

Assuming that the system is metered and that machine billing is not used, the customer's bill should be designed to show the date it is rendered, the present and previous meter readings, the dates on which the readings were obtained, the consumption, and the amount of the charge. Arrears should also be shown, but, in order to conform to postal regulations, they should be designated "other charges." If there is sufficient space available, it may also be desirable that the customer's bill show the schedule of rates. Many companies, however, replace this with a note stating that a rate schedule can be obtained at the utility office. The cashier's stub should show the date of the bill, the total amount due, and the account number. The bill and cashier's stub are mailed to the customer (in postcard billing, the address would appear on the reverse side), who detaches the stub and returns it with his payment.

The ledger card should indicate the date of the billing and the total amount due on the account. There may also be provision for showing the meter readings and consumption, but this information is of secondary importance as it is readily available from the meter

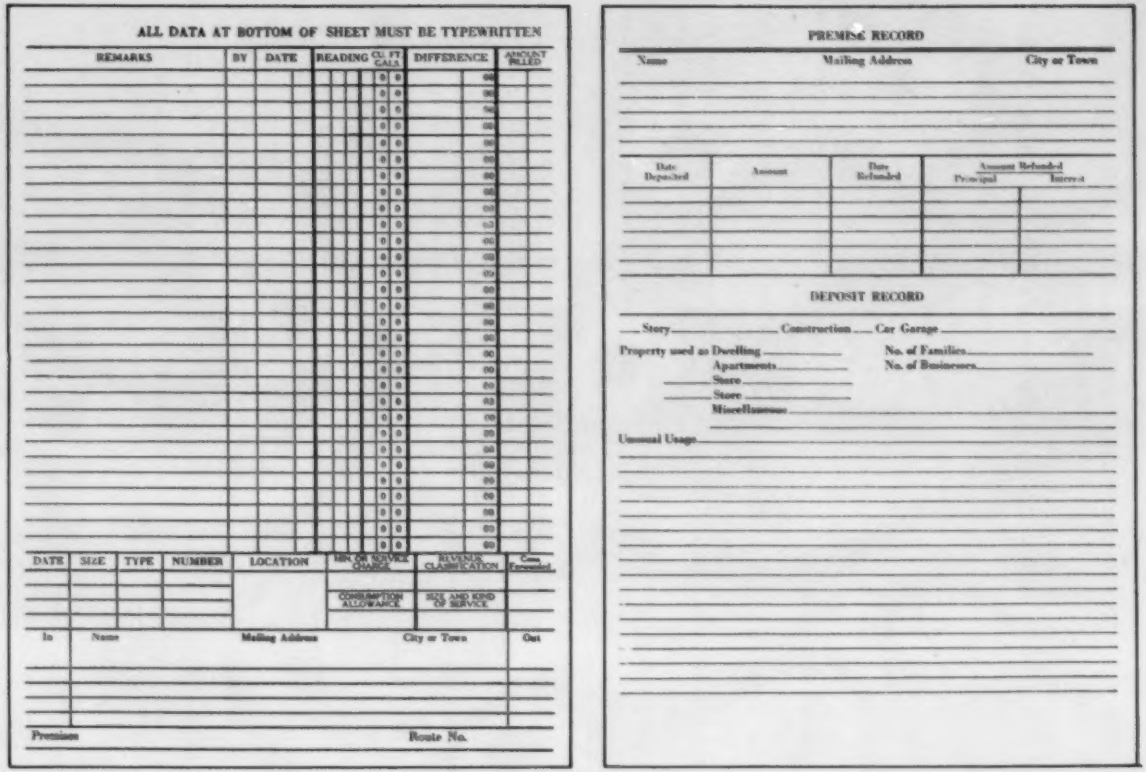

Fig. 2. Meter Book Sheet

Left—front; right—back. The actual page size is 6 × 9½ in., including margin for holes punched at top of front side.

WA

Left—front; right—back. The actual page size is 6 × 9¼ in., including margin for holes punched at top of front side.

book. In addition, provision should be made for recording partial payments. It may also be desirable to provide a space for the determination of the age of delinquent accounts. This can be accomplished by listing the dates of previous unpaid bills and the amounts applicable to each period.

Route Control Ledger

To record the activity of the customers' accounts, a route control ledger is employed, with one ledger sheet for each meter book. The route control ledger sheet should be designed to record by days the activity of the accounts for a period of a month. The simplest type of form should provide columns for listing the balance of unpaid accounts at the beginning of the month, the billings made during the month, the cash collected during the month, allowances and discounts given during the month, and the balance of unpaid accounts at the end of the month (Fig. 6). A more elaborate form would provide columns for such items as checks that may be returned, application of customer guarantee deposits toward the payment of bills, and various other transactions that may arise. A summary control sheet, listing the monthly totals for each route number, should also be prepared every month.

Operation of Accounting System

The mechanics of maintaining a system of customer accounting with these four basic records are quite simple. The use of the service record form needs no explanation. It should be borne in mind, however, that an addressograph plate and meter-reading sheet ought to be prepared as soon as possible after an application for water service has been approved.

The first step in the billing procedure is to address the customer's postcard bill. The addressograph plates should be in the same order as the meter-reading sheets, thereby eliminating the sorting of bills during the billing period.

Meter No. ..... Date .....

Name ..... Acct. No. .....

Address .....

Our meter reader called at your premises today to read your water meter but was unable to gain admission.

To avoid having to render an averaged bill, will you kindly read the meter, marking the figures on this diagram of the dial; note the date of reading, and return to us promptly. This card requires no postage.

Thank you.

RIVERTON-PALMYRA WATER CO.

□□□□□0

Date of reading .....

HOW TO READ METER

You will observe at the extreme right the figure 0, stationary on the dial. The slot with 5 rotative discs is the register. Begin at right, nearest 0, and fill in all figures.

Fig. 3. Customer Meter-reading Card

The card can be adapted for use with dial meters.

After the meters have been read, the water consumption is computed and the amount of the bill is determined from a chart. All of this information is entered in the meter book. It is then necessary only to copy the information from the meter book to the customer's bill and ledger card. Immedi-

FLAT RATE BILLING CARD

DATE OF INSP.	INSPECTOR	CHECKED BY

Date of Change							Billed	
FIXTURES	No.	Amt.	No.	Amt.	No.	Amt.	Date	Amt.
First Faucet								
Additional Faucets								
First Toilet								
Additional Toilets								
First Bath Tub								
Additional Bath Tubs								
First Shower								
Additional Showers								
Hose Bibbs								
TOTAL								

PREMISES:

Service Turned on Date	SEND BILL TO	Tenant or Owner	Service Turned off Date

Account Number _____ Class of Service _____

DEPOSIT RECORD

Name _____ Mailing Address _____ City or Town _____

Date Deposited	Amount	Date Refunded	Amount Refunded	
			Principal	Interest

PREMISE RECORD

Story _____ Construction _____ Car Garage _____

Property used as Dwelling _____ No. of Families _____
Apartments _____ No. of Businesses _____
Store _____
Store _____
Miscellaneous _____

Unusual Usage _____

Fig. 4. Flat-Rate Ledger Sheet

Left—front; right—back. The actual page size is 6 × 9½ in.

The Riverton and Palmyra Water Company

Office: Morgan and Bank Aves., Palmyra, N. J.

Bill for Water Service

METER READING IN GALLONS				Consumption in Gallons	AMOUNT DUE	
		Present	Previous			
		00	00	00	$	

If receipt is required, present entire bill, or mail with stamped, addressed return envelope.

Arrears

CONSUMER'S RECORD

Paid by Check No. ..... Date ..... Total $

Schedule of Rates

Fixed Service charge per Quarter For	⅝ in. Meter	$1.50	Plus Water Consumed Per Quarter For	First	30,000 gals. 40c per M
	¾ in. Meter	2.70		Next	30,000 gals. 35c per M
	1 in. Meter	5.40		Next	30,000 gals. 30c per M
	1½ in. Meter	13.50		Next	30,000 gals. 25c per M
	2 in. Meter	18.00		All over	120,000 gals. 15c per M

Minimum Bill, $4.00 per Quarter. Fixed Service Charge payable in advance. Bills are due within fifteen days of date; prompt payment is requested.

Detach this Stub and mail with Check

$ .....

Total

Riverton and Palmyra Ledger

Meter Reading Dates		Consumption in Gallons	Amount Due	
Present	Previous			
00	00	00	$	
			Arrears	
Payments			Total	

Analysis of Arrears		
Date	Amount	
Total		

Fig. 5. Customer's Bill and Ledger Card

Top—bill and cashier's stub; bottom—ledger card. The ledger card, originally attached at the right of the cashier's stub, is removed before the bill is mailed.

Left—front; right—back. The actual page size is 6 × 9⅔ in.

ately preceding the mailing of the bills, any unpaid amounts from the previous billing period should be transferred to the current bills and ledger cards.

Upon completion of the billing, three adding-machine tapes should be run: [1] on the amounts billed, to determine the total billing; [2] on the amounts due, which will include arrears from the previous billing period; and [3] on the consumption, to determine the quantity of water sold. The total amount of billing, as indicated by the first tape, is recorded in the route control ledger in the column provided. This amount, when added to the previous balance of unpaid accounts shown on the route control sheets, must agree with the total obtained on the second tape.

At this point in the billing procedure, the ledger card section is detached from the customer's bill and placed in a file. One of the most common methods is to separate the file drawer into two sections, using one for the unpaid accounts and the other for the paid accounts. The drawback to this system of filing is that trouble can be caused if a card becomes lost or misplaced. The author prefers that each group of ledger cards representing the accounts in one meter book be fastened together. This can be accomplished by having the printer prepunch the ledger card section of the bill midway between the top and bottom of the card on the extreme left. The cards are then joined together with a metal fastener that may be purchased at any stationery store.

For Month Ending _____ Route No. _____

	Explanations	Balance Beginning of Month	Billing	Penalties	Credits			Balance End of Month
					Cash	Allowances and Other Credits	Discounts	
1								
2								
3								
4								
5								
6								
7								
8								
27								
28								
29								
30								
31								
	Total Month							

Fig. 6. Route Control Ledger

A sheet of this type is kept for every route number, and entries are made daily.

In the posting operation for the payment of customer accounts, it is necessary for every payment to be represented by a cashier's stub. At the end of each day's activity, the amount in the cash drawer should be balanced against the total of the stubs; thus, the chance of finding mistakes is greater than if the cash drawer is balanced only once or twice a week.

Each day's collection of cashier's stubs is sorted and placed in numerical sequence and route number order. An

adding machine then provides totals by route number and the complete daily total. The latter represents the collections for the day, and this amount should be deposited in the bank. The total amount collected from accounts in each route is posted to the route control ledger sheet. The individual payments are posted to the ledger cards by stamping them with the date of payment. Those ledger cards that are paid in full are then turned around the fastener to a position directly opposite the accounts that remain unpaid. By placing the paid cards in this position, it is possible to estimate at a glance the number of accounts with outstanding balances.

A count of customers is generally required at least once a year. This can be obtained by placing at the back of each meter book a fly sheet on which is noted the number of accounts contained in the book, classified as to the type of service. These figures can be kept up to date by adding each new account and deducting each closed account.

This discussion has barely scratched the surface of the subject of commercial records. Many types of forms not mentioned can be, and are being, used in commercial accounting. The author believes, however, that the four basic forms outlined will meet the requirements of most small water systems.

Reprints Available

Reprints of the following articles, published in the JOURNAL during the preceding year, will be available from the Association in small quantities, at the prices noted. until the present stock is exhausted. Order by reprint number and author's name from: Order Dept., American Water Works Assn., Inc., 521 Fifth Avenue, New York 17, N.Y. Prepayment required on orders under $2. (Note: This list does not include specifications and similar documents kept permanently in stock.)

Reprint No.	Author	Title	Issue of JOURNAL	No. of Pages	Price per Copy
353	ERICKSON	Revenue Bond Financing	Apr 54	4	15¢
354	BDSA STUDY	Use of Cast-Iron Pressure Pipe	Apr 54	6	20¢
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356	HANEY	Theoretical Principles of Aeration	Apr 54	24	35¢
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368	BELL, THOMAS, ROSENTHAL	Passage of Nuclear Debris Through Treatment Plants	Oct 54	14	25¢
369	HARRIS	Decade of Fluoridation	Oct 54	6	20¢
370	PANEL DISCUSSION	Fundamentals of Operation	Oct 54	15	25¢
371	PANEL DISCUSSION	Oil Pipeline Failures	Oct 54	11	25¢
372	PAUL	Valve Selection	Nov 54	20	30¢
373	CUNNINGHAM	Wood Stave Pipe	Nov 54	10	25¢
374	CHLORINE INSTITUTE	Stationary Chlorine Storage	Nov 54	12	25¢
375	WOLMAN	Providing Water Service	Jan 55	8	20¢

Report of the Committee on Water Works Administration

For the Year Ending December 31, 1954

A report of the activities of the Committee on Water Works Administration for the year ending Dec. 31, 1954, submitted to the AWWA Board of Directors on Jan. 17, 1955, by Wendell R. LaDue, Chairman.

As outlined on pages 192–93 of the 1954 AWWA *Directory*, the present organization of the Coordinating Committee on Water Works Administration provides for 21 subcommittees, grouped in four classifications, with about 120 AWWA members participating. The general committee consists of the chairman, the general chairmen of the four groups, and the chairmen of the various active subcommittees. Other members of the various subcommittees are not members of the Committee on Water Works Administration. Committee work has been broadened by the creation of "task groups," subordinate to technical divisions. The chairman of a task group is not a member of the Committee on Water Works Administration, but, in general, works within the province of the division under which the task group functions. When the work of the task group covers activities in various divisions, however, the chairman becomes a member of the committee. The present committee personnel are:

W. R. LaDue, *Chairman*

F. C. Amsbary Jr.
L. E. Ayres
J. J. Barr
M. B. Cunningham
R. J. Faust
E. L. Filby
L. S. Finch
M. P. Hatcher
H. E. Hudson Jr.
A. P. Kuranz
D. L. Maffitt
J. H. Murdoch Jr.
L. A. Smith
A. A. Ulrich
W. V. Weir
H. E. Jordan, *ex officio*

Personnel and Organizational Changes

Committee activities and personnel have been subject to continual study. At the 1954 Convention, the following items were approved by the AWWA Board of Directors:

The Water Works Management Division was given the assignment to set up a task group to develop job classifications in the water works industry.

The Water Distribution Division was given the assignment to set up a task group to consider control and reduction of non-revenue-producing (unaccounted-for) water.

The Water Works Management Division was given the assignment to develop one or more task groups to implement certain phases of the "New Horizons" project presented by P. S. Wilson, secretary of the Fuller Award Society. These proposals fall generally within the province of water works management.

The Water Works Management Division was asked to develop a task group to make a survey disclosing current practices in the diversion of water

works funds to and by other municipal agencies.

Reference was made to the confusion existing in the minds of some of the division officers concerning the relationship between the divisions and the correlating committees, with particular emphasis upon responsibility. R. J. Faust prepared a very careful analysis of the problem, and copies of his report were forwarded to the AWWA Officers and Directors and to all division officers on Jul. 8, 1954. This clarification will prove highly useful and timely.

H. H. Kansteiner was assigned to Task Group A4.F—Rules and Regulations (NARUC) to replace G. D. Pelton.

Inactive Subcommittees

The following subcommittees are now inactive or have not been activated:

A1.A—Constitutional and Statutory Aspects of Municipal Water Works Organization

A1.E—Taxation and Revenue Allocation (task group active)

A2.B—Management Relations

A3.A—Construction, Equipment, and Materials Contracts

A3.B—Valuation and Depreciation

A3.C—Cost Trends

A4.A—Water Department Reports (adviser retained)

A4.C—Joint Administration of Water and Sewer Facilities (adviser retained)

A4.G—Revenue-producing Water (task group active).

1954 Convention

At the 1954 Convention, twelve principal topics stemming from the committee's activities, either directly or indirectly, were presented at the various sessions. Attendance at the sessions was good, and member interest was unusually high.

Subcommittee Activities

The continuing and growing interest in the field of water works management and administration is evidenced by the steady flow of inquiries into AWWA headquarters regarding committee activities. These questions cover a wide variety of subjects, indicating a need for increased activity in all phases of the committee's present field of endeavor and expansion into other fields, as the AWWA programs will permit and as the membership requires.

The following is a brief summary of the activities of the several subcommittes during 1954:

A1.A—Constitutional and Statutory Aspects of Municipal Water Works Organization. Although this committee is inactive at present, it is pertinent to mention under this heading the Eugene, Ore., Water and Electric Board publication entitled, "Report of Special Studies Analyzing Payments by Typical Publicly Owned Utilities to Units of Local Government—Theory and Practice," which lists:

Four benchmarks for policy analysis:

1. Cheap and abundant water is a necessity for the American way of life.

2. Water works management, particularly in the furnishing by water boards, has made notable progress in plant, in customers, and in consumption. Water boards in particular have attained a high degree of legal autonomy.

3. Growth and prosperity in metropolitan areas have sorely taxed antiquated forms of government.

4. Water utilities are enmeshed in problems of growth and prosperity, chiefly because legal city limits and logical service areas do not coincide.

The entire import of the report is so timely that it merits widespread present discussion, and consideration as future AWWA convention material.

A1.B—Radio and Mobile Communication Facilities for Water Works. Committee activity in 1954 consisted largely in encouraging manufacturers to advise water utilities of the value and savings in the cost of operations to be gained by using mobile radio communications. Also, the committee has worked with the National Committee on Utilities Radio and with federal groups in an effort to see that equal consideration is given to water utilities in various matters connected with mobile communications. There is under consideration the sending out of a questionnaire to obtain information from the water works industry on the fields in which committee assistance would be of service.

A1.C—Water Use in Air Conditioning and Other Refrigeration. The committee has no active work in progress at the moment. It feels unanimously that it has covered the subject and should now be placed on inactive status, reporting only if something of importance arises.

The committee reported that the most equitable approach to control without discrimination was generally through the institution of a demand charge. This has since been recommended by the Committee on Water Rates (March 1954 JOURNAL). Furthermore, a precedent has now been established for the demand charge by the approval of such a charge by the Arkansas Public Service Commission. The St. Louis County Water Co. has filed with the Missouri Public Service Commission an application to permit it to set up a demand charge. Similar steps are planned by the Northern Illinois Water Corp. (for Champaign-Urbana) and the Illinois Water Service Co. (for Pontiac) in the spring of 1955.

The American Institute of Management, in September 1953, published an industry appraisal under the title, "Air-conditioned America." This is the most comprehensive appraisal of what may be expected in the future with regard to air-conditioning installations. The July–August 1954 issue of *Monsanto Magazine,* in an article on the subject of air conditioning, published a map of the United States showing the percentage of total sales for each region. The committee believes it safe to assume that sales for the next few years, at least, will follow the same geographic pattern. Committee Chairman F. C. Amsbary Jr., in a paper presented at the 1954 Florida Section Meeting, included the pertinent points from the publications mentioned above. Each AWWA member can, from these data, appraise the probable impact on his community. In doing so, however, he should bear in mind the possibility that a community which has had no water use problem resulting from air conditioning will, after a few installations have been made, find it to be a most infectious movement. Its growth can be phenomenal, and control steps should be taken before the situation becomes serious. It is believed that a proper understanding of the influence of air conditioning upon "load growth" is yet to be clearly defined.

A1.D—Water Use in Fire Prevention and Protection. As a result of the meetings of this committee there was developed: [1] a review of data required by the National Board of Fire Underwriters; and [2] a panel discussion at the 1954 Convention, under the title, "Fire Insurance Rating Problems" (August 1954 JOURNAL). With

information from these sources at hand, the committee is in a position to set up a continuing program, embracing rate classifications, evaluation, and coverage. The old problems of hydrant threads and standardization of nozzles are matters for study by the Water Works Practice Committee.

A1.E—Taxation and Revenue Allocation. Although this committee has not yet been formed, AWWA has had occasion to present the water works viewpoint on the important subject of the costs of relocation of facilities resulting from highway construction. At a congressional hearing held on Jul. 7, 1953, by the Subcommitttee on Roads of the House Public Works Committee, a strong presentation on behalf of relief legislation was made by representatives of the National Assn. of Railroad and Utilities Commissioners, the National Institute of Municipal Law Officers, and telephone, gas, electric, telegraph, and street railway groups. Harry B. Shaw appeared for the water works industry and filed a statement. There was also filed, for all utilities, a tabulation covering utility costs in twelve selected states from various parts of the country. The data showed that the relocation cost borne by the utilities amounted to 2.34 per cent of the total cost of the highway work. In 1953, before a Senate committee, representations had been made that reimbursement of utilities' costs would reduce highway mileage by 30 per cent. It was felt that this percentage was an exaggeration. As a result of the detailed study referred to, this exaggeration has been "nailed to the post." The relocation problem remains constantly before water works managers, as the stepped-up program of superhighways and turnpikes develops and continues to expand.

A2.A—Public Relations. Routine assistance to the AWWA staff in preparing *Willing Water* has continued to be made available.

As the Board of Directors has given consideration to requesting the Post Office Dept. to issue a stamp for the seventy-fifth anniversary of the Association, this committee's personnel has been active in promoting the groundwork. Chairman E. L. Filby is planning a trip to Washington in the near future in an attempt to establish interest in the subject.

The 1946–48 public relations series, "Silent Service Is Not Enough!" was reprinted in the December 1954 JOURNAL and is being issued as a separate manual. Although such publications may not be committee projects, they are a vital force in public relations and require committee assistance and collaboration.

The committee recommends that AWWA headquarters join the Water and Sewage Works Manufacturers Assn. in supporting a plan to use television and radio to publicize the 1955 Convention.

A2.C—Compensation of Water Works Personnel. The committee has submitted a final report, containing the following conclusions: [1] salary schedules for administrative and engineering positions are available through ASCE and ASPE (American Society of Professional Engineers) studies; [2] no effective work can be done *on a national basis* with regard to salaries for construction, operation, and office employees; and [3] fixing of compensation is only a part of the problem—dignifying of the water works profession is a compensation to be developed by a public relations program.

AWWA headquarters is now evaluating the results of a survey of employment conditions made in March 1954,

which will prove basic in directing future activities of this committee. From the survey, it is obvious that a great deal can be gained by a better understanding of the interrelationship of employee tasks in a single utility. The results have proved both gratifying and confusing, and are being carefully weighed before publication.

A2.D—Pension and Retirement Plans. Pressure to place state pension systems under the Federal Social Security Act continues. National attitudes toward all types of pension systems will affect the water works field and will bear constant attention.

A2.E—Safety Practices. The main activity of the four task groups of this committee has been the preparation of a safety manual for water utilities. Copies of the first draft were sent to the Board and to a selected group of other AWWA members for review and comment. Suggestions for changes and additions were many. Applying the suggestions to the text was time consuming but quite beneficial to the document. The first draft consisted of 170 pages of mimeographed material. Some members complained that the document was too large and should be reduced in size, while many others suggested additions, not only of paragraph size, but of sections of wholly new material. It is easy to agree with both positions, and obviously the committee will not be able to satisfy everyone. Certain portions of the initial draft have been deleted, and some material has been added. The finished draft will be large, but possibly no larger than was contemplated when the assignment was undertaken. At that time it was estimated that the final manual would comprise about 100 printed pages. A complete index will make the subject material readily accessible to the user, so that the size should not prove a detriment. Chapters 1 and 2, on "The Need for a Safety Program" and "Accident Prevention Program," respectively, are being revised by a professional writer to make them more attractive to the reader. Chapter 3, "Safe Work Practices," is being rewritten by the committee chairman, with the advice and counsel of the members. It is planned to complete the manual in the first half of 1955. It will be published serially in the JOURNAL to permit each member to obtain a copy. Reprint copies, suitably bound, will also be available for purchase. The manual, as developed, will be applicable to small, as well as large, water utilities.

Safety in water works is creating very great member interest and more active participation than any other phase of water works personnel management. The committee is to be complimented for its activity.

Water has now taken its place with electricity, gas, and communications as a component part of the Utilities Section of the National Safety Council.

A3.A—Construction, Equipment, and Materials Contracts. Although no committee activity is in progress, it is of interest to note that the Association's attention has been directed to the recently released "Uniform Public Works Engineering Construction Forms," prepared jointly by the American Public Works Assn. and the Associated General Contractors of America. The forms cover such items as invitations to bid, instructions to bidders, proposal, agreement, and general conditions of contract. It is expected that this document will merit review by a proper AWWA task group.

A3.D—Water Main Extension Policy. This committee has been continuously active. With the population trend producing suburban develop-

ment, public service commission policies regarding main extensions will bear close watching. A questionnaire is being developed for use in determining all utility commission regulations or policies on the subject. It is expected to include questions which will reveal the general extent of control exerted by commissions over operations of water utilities, both municipally and privately owned. This work will be completed during the spring of 1955. After completion of the survey and before the 1956 Convention, an attempt will be made to get the committee to agree upon a method, or methods, of computing free extensions and making refunds which can be offered as an AWWA recommendation. The entire subject is of direct, pertinent interest to members.

A4.B—Water Rates. Reports of the meritorious activities of this committee have appeared in the JOURNAL and have been given at AWWA conventions. The committee deserves high commendation for completing an arduous and lengthy job. It is presently on a standby basis, although revision of water rates is a necessary part of the proper administration of a healthy water utility. The control of the funds provided by rates is also a matter for constant surveillance, as successful operation and expansion require that the water utility have the use of its own revenues.

A4.C—Joint Administration of Water and Sewer Facilities. Owing to the general acceptance of the sewerage service charge and its collection by the water utility office, the trend toward joint administration is expanding, with attendant problems. This committee should resume active status.

A4.D—Water Use. The two task groups (A4.D1—Industrial and A4.D2—Domestic) are now combined under the chairmanship of H. E. Hudson. The committee's task may be defined briefly: It will continue its studies of the kinds of water needed to fill industrial requirements and will outline the various schemes for industrial water conservation. It will study the various kinds of domestic (residential) uses, with particular stress upon seasonal and hourly variations. Although residential requirements may at present appear to be the paramount factor in public water supply systems, industrial requirements may, in the long run, become far more important for future planning. The many divergent uses of water will, in time, produce areas of conflict, requiring careful analysis of the possible priority of use of some supplies. The activity of Committee A4.D should be increased and its personnel reviewed and strengthened.

A4.E—AWWA Committee to Cooperate With NARUC Committee on Revision of System of Accounts for Water Utilities. The committee has continued its work throughout 1954 and has met on two occasions with representatives of the NARUC committee. A revised draft of the "Uniform System of Accounts for Water Utilities" has been prepared, and copies were received at Chairman J. J. Barr's office on Dec. 30, 1954.

At the January 1954 meeting of the AWWA Board of Directors, the major changes proposed in the new draft were reported. It was evident that many of the Board members felt that the provisions on depreciation were objectionable, and the NARUC representatives were so advised. Although their position was not exactly the same, representatives of the electric and gas industries also expressed objections to the proposed depreciation provisions. As a result of what might be termed a uniform front on the part of the indus-

try, the NARUC representatives have agreed at this time to maintain substantially the same definition of depreciation as that contained in the presently effective system of accounts.

The dates of Jan. 17–18, 1955, were fixed for a meeting between representatives of the AWWA committee and the NARUC committee to review and discuss the current draft of the uniform system. Chairman Colbert of the NARUC group has advised that it is his intention and goal to submit the new system to his association for action at its meeting in the fall of 1955. He hopes, of course, that his association will take favorable action. The AWWA committee was unanimous in its belief that the new system contains many beneficial changes and that its adoption should be sanctioned.

It is felt that accounting systems, which unfortunately make very dry reading, are not suitable material for detailed consideration at a general AWWA convention session, particularly because such systems apply to a rather small segment of the operations represented.

This committee's approach to the problem is excellent.

A4.F—AWWA Committee to Cooperate With NARUC Committee on Proposed Rules and Regulations Governing Water Service. On Oct. 8, 1953, copies of the rules and regulations under consideration by the NARUC Committee on Engineering were submitted to the AWWA Officers and Directors as a report of committee progress. The AWWA committee is attempting to cooperate with the NARUC Engineering Committee, and several conferences have been held. The work might have been completed, but the AWWA group has been unable to secure from NARUC the latest revision of the proposed rules. Cooperation seems to be rather one-sided, as the chairman of the special committee of the NARUC Engineering Committee does not keep the AWWA committee informed of developments. Chairman J. H. Murdoch Jr. and his committee are performing an arduous task well.

A4.G—Revenue-producing Water. A task group on this subject will be set up by the Water Works Distribution Division.

Recommendations

The attention of the Board is again directed to the necessary enlarging of the activities of the Committee on Water Works Administration along several lines, as previously noted. There are numerous projects of the general committee which cannot be handled efficiently strictly on a member committee basis. They involve a large amount of research and could best be handled as staff projects. The AWWA budget might be supplemented by outside funds, especially when the project involves items in which manufacturers or other industries are vitally concerned. The activities which might be considered as staff projects are those of Subcommittee A1.A, A2.C, A4.E, and A4.F, as described above.

A review of the action of the Board in discharging the Task Group on Training Conferences and Certification and its reactivation as a committee of the Board is requested. This subject is primarily one of administration and is believed to be within the scope of the Committee on Water Works Administration, possibly as an assignment to A2.B—Management Relations.

Report of the Committee on Water Works Practice

For the Year Ending December 31, 1954

A report of the activities of the Committee on Water Works Practice for the year ending Dec. 31, 1954, submitted to the AWWA Board of Directors on Jan. 17, 1955, by Louis R. Howson, Chairman.

THIS report covers those activities of AWWA which are under the jurisdiction of the Committee on Water Works Practice. The year 1954 was the thirty-fifth continuous year under which this committee has operated for the benefit of the industry. A very impressive list of standards has been issued under the auspices of AWWA, or by AWWA in cooperation with the New England Water Works Assn. and the American Standards Assn. This report contains certain recommendations relating to new projects which appear to merit consideration and action by the AWWA Board of Directors.

Status of Specifications

A100—Deep Wells. First officially adopted in 1946 and then revised and readopted in 1952, these specifications are not under reconsideration. J. C. Harding, who was the chairman of the committee that developed the specifications, acts as adviser to the Water Works Practice Committee.

A101 (Proposed)—Deep Well Vertical Turbine Pumps. On Oct. 15, 1954, the committee on these specifications (ASA designation B58), operating under ASA procedure with AWWA as sponsor, filed a formal report transmitting the document as accepted by the unanimous vote of the committee. The text is now being put into type and prepared for submission to the Water Works Practice Committee and the Board of Directors of AWWA and to ASA. This most important project has been in progress since 1949, under the cochairmanship of M. H. Owen, of the Los Angeles Dept. of Water and Power, and P. H. Brown, of the Johnson Pump Co. The committee included twelve additional representatives of AWWA, plus individual representatives of the American Institute of Mining and Metallurgical Engineers, the American Public Works Assn., the American Society of Mechanical Engineers, the Conference of State Sanitary Engineers, the National Assn. of Vertical Turbine Pump Manufacturers, the National Institute of Governmental Purchasing Agents, the New England Water Works Assn., and the US Navy Dept.

The committee now proposes to extend its activities into the development of a set of specifications for submersible turbine pumps. The committee should be commended for its diligence and efficiency in completing the first assignment given to it and the Board should approve its further activity in the development of the specifications for submersible pumps. [The Board approved.]

B100—Filtering Material. No revisions of the current document, made Standard in 1950, are under consideration.

B200–B700 Series—Water Purification Chemicals. The work on these specifications, which has been carried on for several years under the general direction of James E. Kerslake, is a highly creditable activity for which he and his associates deserve the greatest appreciation. A list of all of the documents in this category is given in Table 1.

TABLE 1

Specifications for Water Purification Chemicals

Specification	In JOURNAL	Made Standard
B200—Sodium Chloride	Mar. 1950	May 1953
B201—Soda Ash	Feb. 1952	May 1953
B202—Lime	Jan. 1953	Sep. 1954
B250—Cation Exchanger Test Procedures*	May 1949	May 1951
B300—Hypochlorites	Oct. 1953	
B301—Liquid Chlorine	in hands of referee	
B400—Ammonium Sulfate	Nov. 1950	May 1953
B401—Bauxite	Jul. 1950	May 1953
B402—Ferrous Sulfate	Oct. 1950	May 1953
B403—Alum	Nov. 1952	May 1954
B404—Ferric Sulfate	in hands of referee	
B405—Sodium Aluminate	first draft prepared	
B406—Silicates for Activated Silica	final draft submitted	
B500—Trisodium Phosphate	Jun. 1950	May 1953
B501—Caustic Soda	Dec. 1951	May 1953
B600—Activated Carbon	Feb. 1951	May 1953
B601—Sodium Pyrosulfite	Jan. 1954	
B602—Copper Sulfate	in hands of referee	
B701—Sodium Fluoride	Sep. 1950	May 1954
B702—Sodium Silicofluoride	Aug. 1954	
B703—Fluosilicic Acid	Nov. 1954	

* This is not a specification for the material.

It has been suggested that a specification be prepared for materials widely used in the field under the name of hexametaphosphate or polyphosphate. These materials are used to inhibit the precipitation (in distribution mains) of iron in iron-bearing ground waters, as well as to reduce the corrosivity of water. Unfortunately, certain patent controls affecting the production of these materials make it difficult, if not almost impossible, for a standard to be drawn up at this time. These materials are widely sold under commercial trade names, and some appear to be of doubtful value for the purposes for which they are represented to be useful. It is believed that the question is one which the officers of the Water Purification Division should meet by the appointment of a special task group to review the various aspects of the situation. [The Board approved.]

C100 Series—Cast-Iron Pipe and Fittings. The development of these specifications under ASA procedure after 27 years of continuous effort, under Thomas H. Wiggin's direction, has come to a pause because of the fact that, with the exception of ASA A21.1 (AWWA C101—Recommended Practice Manual for the Computation of Strength and Thickness of Cast Iron Pipe), no revisions are current. The revision of A21.1 is being typeset, as far as the text has been agreed upon. Discussions of the sections on "Estimation of Earth Loads" and "Truck Superload and Impact" remain to be concluded before the revision can be completed. As soon as possible the revised text will be circulated in preprint form for approval by the sponsors—AWWA, ASTM, AGA, and NEWWA.

The committee has on its schedule for future action the development of specifications for fittings 12 in. and over.

During 1954 AWWA republished the Specifications for Cast-Iron Pressure Fittings, first adopted by AWWA and NEWWA in 1908. The Board authorized the republication of this document in 1950, at which time it was intended only to correct certain

errors which had been found in the table of weights. One revision was published in March 1953, but, after publication, errors not previously brought to the attention of the editorial committee were disclosed. The latest revision bears the publication date of December 1954. It is to be understood that the 1908 text relating to the tables has been given an absolute minimum of revision. The section of the 1908 document having to do with cast-iron pipe was republished, for historical reference only, in the July 1954 JOURNAL. Reprints are available for those who wish to have them in their specifications file.

C200 Series—Steel Pipe. Although the Steel Pipe Committee, under the joint chairmanship of W. W. Hurlbut and H. Arthur Price, continues actively in its consideration of documents under the committee's control, only one document exclusively related to steel pipe—Specifications for Steel Pipe Flanges—has been revised during 1954. Reprints of this document (AWWA C207) are now available.

C300 Series—Reinforced Concrete Pipe. Chairman Ernest W. Whitlock has submitted to the members of his committee a revision of C301–52—Specifications for Reinforced Concrete Water Pipe, Steel Cylinder Type, Prestressed. This document will be submitted to the Committee on Water Works Practice and the Board of Directors for approval after the Reinforced Concrete Pipe Committee has cleared it.

C400—Asbestos-Cement Pipe. Current specifications, approved as Tentative in May 1953 and published in the July 1953 JOURNAL, have not received the consideration by the working committee which was recommended at the time the document was approved. It is, therefore, not recommended that any change in the status of this document be made.

It is, however, appropriate to consider the promulgation of two other documents—a specification for asbestos yarning rope and a specification for the installation of asbestos-cement water mains. Asbestos yarn is widely used in joining bell-and-spigot cast-iron pipe. Research on the characteristics of this material was conducted in 1954 by the Black Laboratories and the information contained in the research report can be used by a committee to develop specifications for the material, if the Board approves. [The Board approved.]

There is every good reason for the establishment of a committee to develop specifications for installing asbestos-cement water pipe. It is recommended that such a committee be approved. [The Board approved.]

C500—Gate Valves for Ordinary Water Works Service. This document, published in 1952, remains Tentative because of certain pending questions relating to the composition of valve stems for installation under special conditions. The questions can be resolved by the time of the 1955 AWWA Convention.

ASA Project on Rotary Cone Valves (B61). Initiated in 1948, this project was formally cancelled in 1954 by the sponsor, the American Society of Mechanical Engineers (ASME). This decision was made because so many patents affecting the construction of cone valves are still in force that it seemed impractical to develop an ASA standard until the patent problem had passed out of the picture.

C501—Sluice Gates. The Committee on Sluice Gates has reported no progress.

C502—Fire Hydrants. The current document was published in the May 1953 JOURNAL and made Standard in May 1954. During 1954 a special task group, made up of California Section active members and manufacturers, was appointed to draw up specifications for "California type" (wet-barrel) hydrants. This group had a very productive session during the California Section Meeting in October 1954, and a consensus has been reached concerning the content of the specifications. The task group should be given formal committee status. The document will be available for consideration within the next 90 days. [The Board approved giving the task group AWWA committee status.]

The Canadian Standards Assn. has circulated for discussion a Canadian standard for fire hydrants. The foreword to the Canadian document contains the following comment: "The primary purpose of this Proposed Revision is to bring our requirements in harmony with the recently revised edition of the Standard Specifications for Fire Hydrants for Ordinary Water Works Service as published by the American Water Works Association." The text of the Canadian document is being carefully studied by representatives of the Canadian Section of AWWA.

C504—Rubber-seated Butterfly Valves. This document, approved in May 1954 and published in the September 1954 JOURNAL, will be recommended for advancement to Standard in June 1955 unless adverse comments are received in the meantime. No such comments have been received as of the date of this report.

Metal-seated Butterfly Valves. The working committee, under the chairmanship of Fred G. Gordon, has circulated several drafts of specifications for metal-seated butterfly valves. The document is expected to be ready for consideration by the Committee on Water Works Practice before mid-1955. The Butterfly Valve Committee, and particularly its chairman, are to be commended for their diligence.

C600—Installation of Cast-Iron Water Mains. During 1954 a section covering the installation of mechanical-joint pipe was approved. [The text was published in the January 1955 JOURNAL and will be included in future reprintings of the specifications.]

The questions which led to the handling of sulfur jointing compounds in provisional sections of the document in 1949 have not yet been resolved and give no promise of a satisfactory solution. It is recommended that the editorial staff be authorized to develop the necessary changes in the text of the C600 document so that the references to and directions for the use of sulfur jointing compounds can be placed in the notes at the end of the specifications. This is essentially what was done when the document was first published in 1949, but it now appears desirable to set up the directions for the use of these materials in a more orderly fashion than at present. [The Board approved.]

C601—Disinfecting Water Mains. The current procedure, which was made Standard in 1954, has not been adversely criticized. No changes are under consideration.

C602—Cement-Mortar Lining of Water Pipelines in Place—Sizes 16

Inches and Over. This document was approved as Tentative in May 1954 and published in the October 1954 JOURNAL. Reprints of this specification are now available.

C700 Series—Meters. James G. Carns Jr., chairman of the committee, reports that a statement concerning substitute materials in water meters in times of national emergency has been prepared for submission to the proper agency in the US Dept. of Commerce. The committee has in process no revision of any of the meter specification documents. It is hoped, however, to be able to present a recommended minimum test specification to cover the acceptance of repaired meters for use.

C800—Threads for Underground Service Line Fittings. During the year the Manufacturers' Standardization Society raised the question of why the AWWA standards for service line connections to water mains differed from ASA B2.1 (Specifications for Threads). The matter was reviewed with James G. Bradbury, AWWA adviser representing the manufacturers of service line fittings. It was pointed out that the AWWA standard for these threads was adopted only after careful consideration of the existing service line fitting threads. The thread dimensions are widely used in the water works industry. There are probably more than 20,000 assemblies of service line tapping tools now in use, all of which would have to be changed if AWWA changed its specification to conform with ASA B2.1. There appears to be no reason why the question should be formally presented to the Committee on Water Works Practice for consideration. It has been noted, however, that the AWWA document makes no statement concerning the composition of the metal in service line fittings. As it is the routine manufacturing practice of the industry to make these castings with an 85–5–5–5 percentage (copper-lead-tin-zinc) composition, it appears proper to write this specific requirement into the specification the next time it is printed.

D100 Series—Steel Storage Tanks. Chairman H. O. Hill has submitted revisions involving the following subjects for consideration by his committee: [1] provisions for automatic welding of tank shells; [2] radiographic inspection procedures for checking the welding of tank shells; [3] the inclusion of steels which are not as notch sensitive as those listed (these steels will be of value in hazardous locations and those with low ambient temperatures. Numerous small revisions to clarify and improve the text have also been proposed. This document will be submitted for approval prior to the 1955 Convention.

Water Resources Division Committees and Task Groups

E2.A—Weather Control. Chairman R. A. Duff reports no activity under the direction of this task group.

E2.B—Production of Usable Water From Salt Water. W. F. Langelier, chairman of the task group on this subject, reported in December 1954:

The chairman has followed all developments and is keeping a file of all important papers and reports relating to the assignment. To date there has been no "production" and research has hardly merged into the development stage. A report at this time would, of necessity, be confined to a chronology of papers and reports which have appeared in print

over the past 2–3 years. It is certain that much which has been done has not been reported, and it is also certain that the accomplishments to date would prove generally disappointing to communities in dire need of usable water.

A competent investigator (C. B. Ellis) concludes in a recent book (*Fresh Water From the Ocean*, 1954): "No longer than 10 years from now (after several million dollars have been spent on research and pilot plant tests) it should be possible to extract fresh water from the ocean on a large scale at a total cost of about 30 cents [per 1,000 gal] at a cheap power location."

In view of the above a report at this time would not serve the best interests of the Association; more time is needed to evaluate properly the many researches which are now in progress.

E3.A—Watershed Protection and Erosion Control. This committee reports no current activity.

E3.B—Public Use of Watershed Areas. This committee has been inactive for several years, largely because its chairman was also chairman of the active Committee on Water Main Extension Policy. Although the subject of public use of watershed areas is not a new one, it is doubtful that the last word about it could be said by any special committee. It would appear desirable for the Water Resources Division to check to see whether or not it wishes to activate a committee to make a report upon this subject at the 1956 Convention.

E4.B—Artificial Ground Water Recharge. Chairman C. H. Bechert, who has rendered fine service, has had a serious and long extended illness and is still in the hospital. John J. Baffa, a consulting engineer with wide experience in ground water investigations, has agreed to take over the chairmanship of this committee. Chairman Bechert had initiated a project, in cooperation with the US Geological Survey and Purdue University, which involved a listing of published articles on the subject of artificial ground water recharge. This work is in the hands of Prof. D. K. Todd, now with the Dept. of Civil Engineering of the University of California. An effort will be made to maintain the relationship of the AWWA task group to this project.

E4.C—Underground Waste Disposal and Control. This task group has been reorganized with Lynn M. Miller, of the Michigan Dept. of Conservation, as the new chairman. It is too early to report any activities under the new chairman.

Water Purification Division Committees and Task Groups

E5.B—Manual of Water Quality and Treatment. Three special task groups were established on this subject. G. R. Scott is chairman of the group assigned the chapter on aeration; H. E. Lordley is chairman of the group assigned the chapter on mixing, flocculation, and settling; and R. L. McNamee is chairman of the group assigned the chapter on filtration. At the end of 1954 the revised chapters on aeration and on mixing, flocculation, and settling had been filed and accepted by the officers of the Water Purification Division. Substantial progress has been made by Chairman McNamee on the chapter on filtration, but the work is not yet complete. It is planned to publish the three revised chapters in the JOURNAL and make them available as reprints to such persons as wish to avail them-

selves of the new information which the revisions will contain.

E5.4—Fluoridation Materials and Methods. J. C. Zufelt has accepted the chairmanship of this important group, which maintains routine contacts with users of fluoride-bearing materials. It is presently proposed to set up tests of the various proprietary test kits which are offered for sale and used widely by smaller plants applying fluorides to drinking water. The opinion of the committee is that such a controlled study of these devices needs to be made.

E5.5—Instrumentation and Methods of Testing Radioactive Contamination in Water. H. E. Pearson is at present making a survey of 50 state and territorial health department laboratories and 124 water department laboratories in the larger cities (more than 100,000 population) and special districts in the United States to learn whether or not personnel and equipment for the study of waterborne radioactive contamination are available. As of Dec. 31, 1954, ten state, one territorial, and 21 water department laboratories had reported that they were equipped for such studies. This is not a satisfactory record, particularly in large cities where the water supply is drawn from a surface stream, lake, or impounding reservoir. The dispersal of airborne radioactive contamination is known to be increasing, and no large city or state is entitled to neglect this element in modern water examination.

E5.6—Molecular Filter Membranes. This committee, under the chairmanship of J. E. McKee, prepared a procedural outline on membrane filter technique which was published in the November 1953 JOURNAL. The procedure has since been written into the tenth edition of *Standard Methods.* The committtee has been continued on a standby basis, however, until such time as the tenth edition of *Standard Methods* appears and the committee is able to take into account developments in the procedure which have occurred since 1953. Should there be no occasion for continued activity by the committee, its discharge will be recommended at the 1955 Convention.

E5.7—Survey of State Regulations on Water Treatment Plant Design. Chairman Miller has reported no progress on this important assignment. In 1953 sanitary engineers in the states of New York, Pennsylvania, Ohio, Michigan, Indiana, Illinois, Wisconsin, Minnesota, Iowa, and Missouri accepted and distributed the committee report on a manual of "Policies for the Review and Approval of Plans and Specifications for Public Water Supplies." This is a very important document. The manual includes sections on surface water sources, ground water sources, pretreatment, high-rate clarification, softening, filtration, disinfection, iron and manganese removal, corrosion control, taste and odor control, fluoridation, pumping stations, equalizing reservoirs, and tanks and standpipes in distribution systems.

It is evident that this manual covers the field not only of the Water Purification Division but also of the Water Resources Division and the Distribution Division of AWWA. It is, therefore, essential that the divisions concerned establish task groups to examine the content of the manual as it relates to the aspects of water supply within the field of each division. This division activity, as well as the constructive interest of the Officers and Directors of AWWA in this important

manual, will be of great advantage to the water works industry; if there are any elements of the manual that merit negative criticism, it should be expressed promptly and upon the basis of adequate information.

E5.8—Synthetic Detergents. The Water Purification Division has established two task groups assigned to this subject. One has to do with the effect of detergents on the treatment of surface water supplies, and the other with analytical methods for determining the amount of detergent present in water. A very fine report covering the assignment of the first task group was prepared under the leadership of Paul D. Haney and published in the August 1954 JOURNAL. This report is receiving the Water Purification Division Award for 1954.

The task group on analytical methods, operating under the chairmanship of J. C. Vaughn, is actively engaged in following out its assignment. A report will be presented at the 1955 Convention.

E5.9—Specifications for Liquid Chlorine. The work of this committee is proceeding in orderly fashion under the chairmanship of L. L. Hedgepeth. A report is scheduled for the 1955 Convention.

E5.10—Biological Infestation of Purified Water. This important group, under the chairmanship of Blair I. Burnson, will present a preliminary report at the 1955 Convention. There is reason to believe that a wider distribution of macroscopic organisms exists in public supplies than the published data would indicate. The committee has two responsibilities—not only to disclose the distribution of such infestations, but also to study and promote treatment procedures which will eliminate them.

E5.11—Manganese Deposition in Pipelines. In November 1954 the Water Purification Division appointed a special task group to study manganese deposition in pipelines (both transmission and distribution). R. E. Dodson has been appointed chairman. It is proposed to set aside a token amount of the funds appropriated in 1955 for research projects to support a survey and abstract summary of the literature of the last 25 years on the matter of manganese problems in water supply—whether in impounding reservoirs, ground water, pipelines, or elsewhere.

E6.A—Water Hammer. Chairman S. L. Kerr is developing a session on this subject for the November 1955 meeting of ASME. The following AWWA members are scheduled to participate in this session: S. L. Kerr, H. F. Kennison, and F. E. Dolson.

E7.1—Study of Breaks in Water Distribution Systems. The consent of the Indianapolis Water Co. to the publication of a detailed, long-term record of breaks in the distribution system of that city has been obtained. This publication will encourage other water works executives to make such information available to the field. It should be noted that this 30-year record is fully objective and indicates no serious disability—either in the cast-iron pipe in the distribution system or in the sulfur compounds or lead used in jointing the pipe.

E7.S—Service Line Materials. This committee is presently inactive. It may appear advisable to set up a special committee or task group to consider the acceptability of nonmetallic service line materials which are now

being widely promoted. AWWA cooperates with certain ASA committees which are presently studying the subject.

Joint Committees

J1—Standard Methods. The publication of the tenth edition of this valued document is set for the end of March. The delays which have been incurred in its publication were beyond the control of AWWA.

J16—Backflow Preventers (AWWA-CSSE). This group, which comprises three members from AWWA and three from the Conference of State Sanitary Engineers, has prepared a preliminary report now under study by the members of the committee. A final draft of the report is scheduled for presentation at the 1955 Convention.

J20—Chlorine Supply (this committee is made up of representatives of the Federation of Sewage and Industrial Wastes Assns., the Chlorine Institute, the Conference of State Sanitary Engineers, the US Public Health Service, and AWWA). The joint committee, after completing the report, "Recommended Procedures in the Use of Chlorine at Water and Sewage Plants" (October 1953 JOURNAL), has considered several additional subjects, such as: [1] chlorine repackaging; [2] caustic soda in water treatment; [3] stationary chlorine storage; and [4] specifications for liquid chlorine. These subjects are all byproducts of the joint-committee deliberations.

The Chlorine Institute agreed to prepare recommendations on specifications for chlorine repackaging. The first draft of the document was prepared in October 1954 and is now in the hands of committee members for review.

Although material on the use of caustic soda in water treatment was developed, the subject was dropped because the chemical is now in short supply and increased use of it is not desirable. Incidentally, chlorine is now in good supply.

The Chlorine Institute has developed recommended specifications for stationary chlorine storage. The document, published in the November 1954 JOURNAL, is an important addition to knowledge on the subject.

J21—Revision of ASCE Manual No. 19, Filtration of Water (ASCE-AWWA). The committee organization is proceeding, but the consent of all persons invited to participate in the activity has not yet been obtained. Joint Committee Chairman Ray L. Derby hopes to achieve full organization by mid-February 1955.

J22—Joint Task Group to Study Need for Committee on Spillway Design and Capacities (ASCE-AWWA). This task group was set up during 1954 to determine if the subject was one which merited joint association study. The AWWA staff developed and handled a questionnaire survey of state regulations. The material was summarized and turned over to the task group in November 1954. The task group now recommends that a joint committee of AWWA and ASCE be appointed to develop standards for spillway design and capacities. [The Board approved the recommendation.]

Committees of Other Organizations

Technical Advisory Board for Research on Decontamination of Radioactive Waters. H. E. Jordan represents AWWA on this board, established by the Atomic Energy Commission and the US Public Health Serv-

ice. The board has promoted an extensive series of research projects on decontamination of radioactive waters. For some months details of a statement concerning the permissible limits of water pollution by radioactive wastes have been under discussion. An agreement has not been reached.

Task Group to Develop Manual on Security Principles for the Water Works Industry. This is a US Public Health Service project in which R. J. Faust represents AWWA. There has been no activity in connection with this project during 1954. An initial draft of the proposed manual, dated April 1952, included 147 mimeographed pages. Following comments by the members of the group, the revision of the text was undertaken, but no further advice has been received from the US Public Health Service.

Relief Valve Research Subcommittee Technical Advisory Group for Domestic Gas Water Heating Research. This AGA Committee, on which A. A. Ulrich represents AWWA, has developed a research report (No. 1151B). The summary section of the report reads in part:

> Despite the experience that water heater thermostats occasionally fail to function properly, hot-water explosions are infrequent. However, when excessive water temperature and pressure conditions do occur, they can cause serious damage to both life and property. Therefore, protective devices are desirable. On nonautomatic storage type water heaters, protective devices are essential.
>
> As long as the maximum water temperature does not exceed 210°F, no explosion can occur, despite the rapid pressure increase associated with heating water in a closed system. Thus, if uncontrolled heating occurs, a high-limit cutoff device or a temperature relief valve is needed to prevent explosion hazards and to minimize scalding injuries or property damage due to steam. A pressure relief device is needed solely to avoid excessive strain on the water tank, due to thermal expansion or pressure surges, and thereby minimize tank failure or rupture without an explosion.

Public Health Advisory Committee of the Chlorine Institute. R. J. Faust represents AWWA on this committee. Its activities during 1954 are covered under J20—Chlorine Supply.

Committee for the Advancement of Sanitary Engineering. This interassociation group, set up by the Sanitary Engineering Div. of ASCE, operates under the chairmanship of Prof. Earnest Boyce of the University of Michigan. The last meeting of the committee brought forth the recommendation that there be established an "American Sanitary Engineering Intersociety Board" to act as a certification center for persons highly skilled in sanitary engineering. This report is subject to approval by the board of directors of ASCE.

Engineers Joint Council. It is required that the officially designated representative of a member body on the board of directors of Engineers Joint Council be a member of the board of directors of the organization appointing him. Charles H. Capen's term as representative of AWWA on EJC has expired, and W. W. Brush has been appointed to take his place. H. E. Jordan acts as alternate. The EJC is promoting a general conference on nuclear engineering, to be held in Cleveland, Ohio, in December 1955. Noel S. Chamberlin and R. J. Faust represent AWWA in connection with this conference.

Civilian Defense Committee; Advisory Committee Engineering Section. R. J. Faust represents AWWA on both of these APHA committees. During 1954 neither committee undertook or completed work requiring special comment.

ASA Committees

AWWA is represented on a group of committees operating under ASA jurisdiction. The record of their 1954 activities follows:

A13—Identification of Piping Systems. A report of the committee submitted for approval in September 1953 resulted in the receipt of quite a few negative votes. The revised draft, submitted in February 1954, also received a substantial number of negative votes. The report of the committee has not been resubmitted.

B2.1—Pipe Threads. This committee had a full-day meeting in November 1954, and a number of reports were considered. No final action was taken on any document.

B16—Pipe Flanges and Fittings. The general committee has reported no specific activity during 1954. The subcommittee on nonmetallic pipe fittings held a meeting on Nov. 30, 1954, at which time a special task group was appointed to gather information on types and dimensions of plastic fittings now in use. There is so much promotion, as well as technical activity, current in the field of nonmetallic pipe and fittings that it seems desirable for AWWA to exercise its interest in the subject through participation in the work of committees operating under ASA procedure rather than to set up special committees of its own. At present, although the producers of plastic pipe are actively promoting its sale and use, it has not yet become sufficiently standardized to be accepted as a service line material by AWWA.

B26—Fire-Hose Coupling Screw Thread. At the 1954 meeting of the National Fire Protection Assn., the special committee of that organization presented a report which included dimensional requirements for 4-, 5-, and 6-in. pumper connections. Efforts to ascertain just where these dimensions were presumed to be effective have not had satisfactory results. It now appears probable that these dimensions were drawn up to govern the design of hose attachments to fire pumper engines. The firm disinclination of AWWA to accept these dimensions as applicable to the construction of fire hydrants has been and will continue to be expressed.

K61—Storage and Handling of Anhydrous Ammonia and Ammonia Solutions. R. J. Faust represents AWWA on this committee. A draft of the proposed standard did not obtain a consensus when distributed in August 1954.

Y32—Graphical Symbols and Designations. R. E. Stiemke represents AWWA on this committee, which, during 1954, developed an American Standard for Graphical Symbols for Electrical Diagrams (Y32.2–1954).

Z34.2—Standards for Drinking Fountains. J. E. McKee, who represents AWWA on this committee, which is under the sponsorship of the US Public Health Service, reports that, since mid-1953, no activity of any sort has taken place within the committee. It is evident that the present standard is not resulting in the construction or installation of drinking fountains which are safe from the sani-

tary engineering standpoint. An effort is being made to stimulate action by the USPHS on revision of this important standard.

Z48.1—Marking Compressed Gas Cylinders. This standard was approved by ASA in May 1954, and the document (Pamphlet C–4) is now available from the Compressed Gas Assn., 11 West 42nd Street, New York, N.Y., at 15 cents per copy. The crux of the standard is contained in the following sentences:

> Compressed gas containers shall be legibly marked with at least the chemical name or a commonly accepted name of the material contained. Marking shall be by means of stenciling, stamping, or labeling, and shall not be readily removable.
>
> Wherever practical, the marking shall be located at the valve end and off the cylindrical part of the body.
>
> The height of the lettering shall be not less than $\frac{1}{24}$ of the diameter of the container, with a minimum height of $\frac{1}{8}$ in.

Miscellaneous

Limitations on Leakage Loss From Reinforced Concrete Reservoirs. The establishment of a task group to develop statistical data on the subject has been proposed, if the Board approves. [The Board approved.]

Control of Oil Line River Crossings. The AWWA Secretary has been advised that the Conference of State Sanitary Engineers has authorized certain of its members to serve on a joint committee with AWWA on this subject. A reply recording the interest of AWWA has been given, but no formal communication has since been received. It appears appropriate at this time to authorize participation in such a joint project if the CSSE wishes to proceed. [The Board so authorized.]

The Ohio River Valley Water Sanitation Commission has developed and published a fine manual on the subject, with the cooperation of the oil industry. It may develop that the acceptance and wide publicizing of this document by the CSSE and AWWA will be sufficient.

Conclusion

The standing of AWWA in the field of technical and engineering standardization is increasingly recognized by engineers and contractors engaged in the design and construction of water supply works. The service of all committee members and the leadership and diligence of committee chairmen are gratefully recognized.

Report on Publications

For the Year Ending December 31, 1954

A report on the publishing activities of the Association for the year ending Dec. 31, 1954, submitted to the AWWA Board of Directors on Jan. 17, 1955, by Eric F. Johnson, Asst. Secretary—Publications.

FOR the JOURNAL, the year 1954 was a banner one economically, a 19 per cent increase in advertising income ushering in the first $100,000 volume, while total costs actually dropped a little, despite the production of more copies and more pages. But the real stars of AWWA's 1954 list were the two booklets, *The Story of Water Supply* and *Your Water Supply*, whose combined sales during the year totaled more than 900,000 copies. Even in the less spectacular areas, publications income more than held its own, as sales of all books increased.

New publications issued during the year were the first of the new manuals —that on water rates—and the teacher's guide to accompany *The Story of Water Supply*. In addition, the main portion of the public relations manual was published in the December Journal, work on the tenth edition of *Standard Methods* was completed, with publication in late March 1955 indicated, and work on the 1940–54 index was begun.

1. The Journal

Detailed data on JOURNAL contents, costs, and income for the years 1950–54 are presented in Table 1.

a. *Contents.* It will be noted that the better balance between text and advertising sections achieved by a 1953 format revision was, to a minor extent, reversed during 1954. This was the result, not of a change in policy, but of the sale of 70 additional pages of paid advertising. To offset the unbalancing effect of these additional pages, the overall size of the JOURNAL was increased, keeping the text material at about its 1953 level. The abstracts section, on the other hand, suffered still further reduction in size, despite the intentions and efforts to restore it to more nearly its prewar volume. This reduction, however, was the result of limited staff time rather than limited space, for the expansion of the advertising section will increase the number of pages available for abstracts.

b. *Costs.* The fact that total costs dropped, while more copies and more pages were being published, has already been mentioned. Primarily, this anomaly resulted from the use of less expensive composition, particularly by comparison with the very costly typesetting required for "The Survey of Operating Data" and its accompanying analysis during 1953. Beyond that, there was a reduction in production costs, reflecting the use of a less elaborate advertising promotion piece for the 1955 renewal campaign. These reductions, of course, carried through to the unit costs as well, where cost per copy dropped, despite the increase in the size, and cost per 1,000 pages fell back almost to the 1952 level, despite the substantial printing rate in-

TABLE 1

Journal Contents, Costs, and Income, 1950–54

Item	1950	1951	1952	1953	1954
Contents					
Text pages	1,210	1,076	1,218	1,378	1,366
Advertising pages	1,286	1,340	1,390	1,182	1,258
Total pages	2,496	2,416	2,608	2,560	2,624
Text articles					
Conference papers	34	32	28	21	24
Section papers	78	44	68	61	67
Contributions	19	20	25	24	36
Reports & official documents	18	22	24	33	18
Total articles	131	96	121	106	127
Abstract pages*	100	94	108	85	75
Costs					
Production	$ 4,049	$ 3,706	$ 5,187	$ 4,921	$ 4,598†
Printing	35,248	37,234	42,521	47,036	46,163
Paper	9,688	10,742	13,876	14,088	15,207
Total costs	$48,985	$51,682	$61,584	$66,045	$65,968
Total-cost index	100	105.5	125.7	134.8	134.7
Cost per copy	42.5¢	42.5¢	45.9¢	47.5¢	46.7¢
Cost per 1,000 pages	$2.01	$2.07	$2.07	$2.19	$2.09
Printing rate index	100	107.9	107.9	113.3	115.5
Paper rate index	100	111.4	118.2	118.2	120.6
Income					
Advertising	$71,562	$72,639	$85,147	$85,076	$100,951
Subscriptions	5,950	6,797	7,094	7,510	8,943†
Total pages paid advertising	818	847	879	856	926
Advertising rate index	100	100	113.3	113.3	124.0
Cost per 1,000 circulation	$8.81	$8.25	$8.73	$8.30	$8.73
Circulation (avg per issue)	8,515	9,094	9,740	10,238	10,654
Circulation index	100	106.8	114.4	120.2	125.1

* On basis of present format.
† Varies from audit figures because of different basis.

crease in the interim. Economies such as these are impossible to budget, as they depend almost entirely on the material that becomes available for publication during the year. Normal is somewhere between the abnormal high of 1953 and the abnormal low of 1954.

c. *Income.* Mentioned before, but certainly worth repeating, is the fact that 1954 was the first $100,000 advertising year. In reaching that level,

sales exceeded by more than $11,000 a budget considered optimistic in the light of a dip in insertions in 1953. Income from subscriptions also increased beyond expectations, as did the net return from sales of reprints and back issues (not shown in Table 1).

As will be noted from a comparison of their indexes, JOURNAL advertising rates have just about kept pace with circulation, a fact which is also reflected in the relatively level advertising cost per 1,000 circulation. If circulation continues to rise, a further adjustment in rates may be indicated for application to 1956 advertising. Although it is too early yet to determine whether an increase will be either justifiable or wise, whenever a recommendation can be made, quick action on it is necessary to give the advertiser maximum notice and, thus, cause the least disruption in regular schedules. For this reason, it is recommended that the Board delegate to the Finance Committee the power to act in its stead in the establishment of JOURNAL advertising rates when requests for action cannot be timed to be made at meetings of the Board. [The Board approved this recommendation.]

d. *The future.* Except for the addition of a few decorative rules around titles, the JOURNAL will have the same format in 1955 as it did in 1954. Neither the author-picture nor the cover-picture proposals of last year received favorable action by the Board, and, although some further aspects of the possibility of splitting the JOURNAL into two publications have been explored, that idea still requires a great deal of study before definite recommendations can be made.

One suggested change on which action by the Board is requested, however, is that of authorizing the provision of a limited number of free reprints of JOURNAL articles to their authors. Investigation has indicated that at least half the association journals make a practice of giving their authors 25–100 copies of their published papers as a token of appreciation. Actually, the JOURNAL at one time did provide such free reprints, but discontinued the practice in the 1930's as an economy measure. With the financial picture more favorable now, it is felt that provision of reprints would be a reasonable method of thanking authors for their contributions. Maximum annual cost, based on making up a total of 50 offprints (prints made at the same time as the JOURNAL is printed) of each paper is estimated at $725 per year. In addition to this direct cost, some reduction in reprint income would also be effected in making the prints available automatically. This loss, however, would be less damaging than might be expected, as the reprint orders thereby canceled would be the small ones, on which overhead costs

TABLE 2

Comparative Data on Directory *Membership List Editions, 1950–54*

Item	1950	1952	1954
Members included	8,296	9,247	10,000
Total pages	320	256	272
Number of copies printed	11,100	12,130	12,643
Total cost	$7,905	$8,527	$9,036
Cost per 1,000 pages	$2.20	$2.70	$2.59
Cost per copy	71.2¢	70.3¢	71.5¢
Cost per member	95.3¢	92.2¢	90.3¢
Total pages paid advertising	45	51	46
Advertising income	$3,680	$4,763	$4,802
Net cost per copy	37.9¢	31.0¢	33.5¢

are disproportionately high. It is recommended that the Board approve provision of up to 50 free offprints to authors, the policy to be put into effect as soon as possible. [The Board approved.]

2. The Directory

From the comparison of *Directory* Membership List Editions presented in Table 2, it will be noted that the size, which was reduced drastically in the 1952 format change, headed upward again in 1954. This enlargement, which was due entirely to AWWA growth between the dates of issue, was actually held below the 8 per cent membership gain by additional economies in makeup. The final step in the effort to achieve better balance between the two editions of the *Directory* will be the transfer of the "Directory of Committees" to the Reference Edition, beginning in 1955.

The increases in *Directory* costs have generally followed the increases in printing and paper cost rates, as reported for the JOURNAL, but, while the cost per copy rose with the increased size, it was possible in 1954 to reduce the cost per 1,000 pages through composition economies and the increase in the print order. Decreasing with other unit costs has been the cost per capita, although it still totals 90 cents per member.

Directory advertising has yet to achieve the popularity it merits, but even the relatively small amount now being sold helps to carry the load, in continuing to pay approximately half the cost of publication. By listing the *Directory* in advertisers' media books as a regular annual AWWA publication and by continued promotion, it is expected eventually to convince advertisers of its merits as a long-term salesman. It should be pointed out that at least some part of the present difference in the number of advertisers between the *Directory* and an issue of the JOURNAL results from the restriction of *Directory* pages to members only.

3. Specifications

Published during 1954 were specifications for sodium pyrosulfite (B601), sodium silicofluoride (B702), fluosilicic acid (B703), butterfly valves (C504), cast-iron pressure fittings (C100), and lining of pipelines in place (C602). In addition, the superseded 1908 cast-iron pipe specifications were republished for historical reference. All these documents are now available as reprints from the JOURNAL.

Sales of specifications for the year totaled $9,593, a considerable drop from the $16,693 of 1953. This reduction was expected, however, as the 1953 appearance of the long awaited A21 specifications had swelled that year's total to an abnormal high. Because income is so greatly affected by initial sales on the appearance of new documents, it is not possible to demonstrate in the accounts the steady growth of day-to-day sales of AWWA specifications. That growth is obvious, though, to those who handle the orders, as is the fact that the growth comes almost as much from increased acceptance of the standards as from the lengthening of the list.

4. Journal Indexes

Sales of both the 1881–1939 index and its 1940–44 supplement fell off during the year, to the point where only 12 copies of the index and 20 of the supplement were sold. The 120 copies of the index left in stock should be adequate to fill all future orders for this volume. The few remaining

copies of the supplement are being held as office samples, since the period they cover is to be included in the new 15-year index.

During the year work on a 1940–54 index was begun, with the expectation that it will be issued sometime in the middle of 1955. Preliminary estimates indicate that the book will run to approximately 200 pages, about two-thirds the size of the present 59-year index, because of additional classifications and cross references. Although a definite decision on the method of printing has not yet been made, informal bids on the book indicate that a budget allowance of $3,500 for 1955 will take care of printing 3,500 copies and binding 1,500 of these in cloth. The list price tentatively planned is $2.25.

Although only 880 copies of the 1881–1939 index have been sold in the past 15 years, it should be recalled that that volume actually superseded one which covered the period 1881–1933, thus adding only 6 years to the previous index. By direct promotion, particularly to JOURNAL subscribers, it is felt that at least the first 1,500 copies of the new index can be sold within a period of 4–5 years.

5. Willing Water

In its second year as a periodical, *Willing Water* continued as an eight-page bimonthly, specializing in public relations, but also giving attention to civilian defense, safety, conservation, billing, and the highway relocation problem. By the use of material which required less expensive printing and production, and by combination mailings, it was possible to hold costs more than 20 per cent below the $6,000 budget. In the expectation of being able to continue these savings, it has been suggested that the budget for 1955 be reduced to $5,000.

Not exactly publications, but nevertheless related to the *Willing Water* bulletin, have been the "Willing Water" newspaper mats and electrotypes and (introduced last September) the "Willing Water" jewelry novelties. On the receipts-and-disbursements books, both items show apparent losses—the first because a complete new series of master engravings was purchased during the year, and the second because receipts and inventory have not yet caught up with disbursements. Both activities are operated on small, but safe, margins.

6. Books

A consolidated financial summary for seven books—five of them published by AWWA, and two jointly with other societies—is presented in Table 3. Omitted are the figures for *Standard Methods*, as its sale has not been handled directly by AWWA. And not included in the expense totals are early development expenses not directly related to the production of the books. These include approximately $3,300 in committee expenses on the *Survival and Retirement* survey, $1,600 in developmental work 5 years before the production of the *Quest* (primarily for the purchase of the M. N. Baker library), and more than $900 of developmental work on the intersociety (ASCE-APHA-FSIWA-AWWA) *Glossary*. As far as is known, these are the only items omitted from the tabulation, except, of course, the considerable items of salary and overhead represented by the work in AWWA headquarters.

Of the two books on which the record is complete, the *Glossary* records a loss, despite the fact that all copies purchased were sold in a few months.

More than anything, that reflects a lack of direct control over the operation, and the project has been written off as a service to the field. Among the books on the current list, only the *Quest* shows a debit balance, and, with time, even that has a good chance of making ends meet. As in the case of the *Glossary*, publication of the *Quest* was approved primarily to fill a gap in the literature of the field, something AWWA accepted as its responsibility.

A review of the 1954 activity of the various books follows:

a. *Standard Methods for the Examination of Water, Sewage, and Industrial Wastes.* During the year, work on the tenth edition was completed, so that the book is now in press and expected to issue by the end of March 1955, the final proofing, correction, and indexing having taken considerably longer than originally estimated. The new edition will run to more than 500 pages, compared with the 300 pages of the ninth edition. The list price has been set at $7.50, with a discount of $1.00 per copy to members who order through their own association and send cash with their orders.

A review of the record of the ninth edition shows that a total of more than 22,000 copies were printed and sold, and that AWWA's share of the profits totaled more than $25,000.

b. *Manual of Water Works Accounting.* Sales: 84 copies in 1954; 32 copies in 1953. The increase in sales of this book, as well as the others on the list, is attributed primarily to the promotional mailing of April 1954.

c. *Survival and Retirement Experience With Water Works Facilities.* Sales: 68 copies in 1954; 51 copies in 1953.

d. *The Quest for Pure Water.* Sales: 77 copies in 1954; 52 copies in 1953.

e. *Water Quality and Treatment.* Sales: 539 copies in 1954; 425 copies in 1953. The revision committees on the aeration and the mixing and sedimentation chapters have already submitted their completed manuscript for the third edition. These new chapters will be published in the JOURNAL and, inasmuch as work on much of the balance of the third edition has yet to begin, reprints of the revisions will be made available for distribution with copies of the book. With 750 bound and 4,800 unbound copies of the second edition on hand, there need certainly be no worry over running out before the third edition is available. At the same time work on the third

TABLE 3

Summary Data on AWWA Books

Year Published	Book	No. Printed	No. Bound	No. Sold	Inventory		Production & Sales Expense $	Income $	Value of Inventory on Hand $
					Bound	Unbound			
1938	*Manual of Accounting*	1,898	1,898	1,414	484		3,266.63	4,980.43	721.16
1940	*Water Quality and Treatment* (1st edition)	3,000	3,000	3,000			4,000.92	7,469.22	
1940	*1881–1939 Index*	1,000	1,000	880	120		1,250.92	1,550.00	144.00
1946	*Survival and Retirement*	3,006	2,000	1,868	138	1,000	4,509.59	5,675.77	1,036.13
1948	*Quest for Pure Water*	2,512	2,021	1,592	429	491	8,583.74	6,802.93	1,339.01
1949	*Glossary—Water and Sewage Control Engineering*	1,000	1,000	1,000			1,556.20	1,508.00	
1950	*Water Quality and Treatment* (2nd edition)	9,300	4,500	3,745	755	4,800	13,402.44	16,399.76	3,532.50

edition should not be affected by the size of the inventory.

7. Booklets

The success story of the two booklets developed at the end of 1953 for the use of water utilities in their public relations work is suggested by the data given in Table 4. As in the book summary, not all developmental costs are shown in the production and sales expense column. For *The Story of Water Supply*, there is omitted the $400 spent in 1954 on development and production of the teacher's manual that is to be given away with the booklets. For *Your Water Supply*, the cost of the original typesetting and distribution of the booklet as part of *Willing Water* is also to be considered a developmental expenditure. Whatever the modifications, though, the sale of 930,000 copies of the two booklets is the real measure of their success.

TABLE 4

Summary Data on Public Relations Booklets

Booklet	No. Printed	No. Sold	Inventory	Production & Sales Expense $	Income $	Inventory Value $
Story of Water Supply	400,000	399,275	725	12,144.89*	19,933.50	12.40
Your Water Supply	537,895	530,445	7,450	8,999.32	13,160.81	94.99

* Includes $2,000 spent in 1953 for development of booklet.

a. *The Story of Water Supply.* As stocks of this booklet had been all but sold out by the end of the year, a new printing of 200,000 copies was ordered, the printer having agreed to provide new plates for the job. One lot of the new booklets was imprinted with price schedules for use in a promotional mailing to all members with the February 1955 issue of *Willing Water.*

The *Teaching Aids* folder, which was prepared by an educational consultant and published by AWWA last November, is now being distributed free with copies of *The Story of Water Supply* in a 1:50 ratio. To introduce this new tool to members, it was reproduced in the February 1955 issue of *Willing Water*, thus making it available for study together with *The Story.*

Although the popularity of *The Story* needs no verification other than its sales record, it is interesting to point out that it has already been translated into Chinese, with 20,000 copies in that language being distributed among 45 water utilities in Formosa, and requests for permission to translate have been received from Mexico, Brazil, and the World Health Organization. By approval of the Executive Committee, the WHO request to translate the booklet into Spanish, Portuguese, and French for distribution in this hemisphere, particularly in conjunction with World Health Day in April 1955, has been granted, and future requests for copies in those languages will be referred to the Pan-American Sanitary Bureau of WHO.

b. *Your Water Supply.* At the end of 1954 the fourteenth printing of this booklet was in prospect, with orders on hand for the first 5,000 of the 30,000 copies required for a printing. Meanwhile the possibility of another promotional mailing of sample copies is being considered.

8. Manuals

a. *Water Rates Manual.* In June 1954 this item, the first of AWWA's new manuals, was issued, including the report of the Committee on Water Rates as it appeared in the March 1954 JOURNAL, plus 30 pages of supplementary material, mostly excerpts from the classical references on the subject. Of the 1,000 copies printed, 210 were sold during the year.

b. *Silent Service Is Not Enough!* Scheduled to appear in March 1955, this manual will include the text of the public relations guide as published in the December 1954 JOURNAL, plus an appendix of facts, statistics, and ideas for use by water works speakers. A budget of $850 has been recommended for this reprint, which will bulk 152 pages and be sold at a list price of $1.50.

c. *Safety Manual.* The text of this manual is virtually complete. Once it has received final approval by the Safety Committee, the text will be turned over to the editorial staff for final editing and for illustration. But, beyond that point, there are a number of alternative methods by which the production and distribution of the manual can be handled:

1. It can be printed as a free supplement to the JOURNAL.
2. It can be published in a single issue of the JOURNAL, with reprints later offered for sale.
3. It can be published in installments in the JOURNAL and then combined into a single reprint manual which would be offered for sale.
4. It can be issued as a separate publication for sale only.

All of these possibilities except Method 1 seem feasible. In involving an unrecoverable cost of between $2,500 and $3,000, that method is thought to be unnecessarily expensive. The feasibility of Method 2 is indicated by the publication of the somewhat larger public relations guide in the December 1954 issue, but it is considered undesirable to overload any single issue in this way, particularly with such an overconcentration on a single subject. Method 3 avoids this drawback and makes it possible to present the safety story in five installments that would not be too formidable for reading in single sittings. And the eventual reprint manual would make all the information available in one place for those who need it for constant reference in their work. Method 4, of course, represents the fundamentally different approach of making the manual available only to those interested enough to buy it. Inasmuch as AWWA undertook the development of the safety manual because of its vital importance to the field, it would seem self-defeating now to limit its distribution to the few who are already aware of the need.

If the manual is published first in the JOURNAL by either method, the cost of typesetting would be absorbed as a JOURNAL expense, and it is estimated that reprint copies of the manual could be offered for sale at a list price as low as $1.25 per copy. As a separate book, bearing its own cost of typesetting, it would have to sell for approximately twice that amount. Whatever the form agreed upon, the manual can be completed during 1955.

It is recommended that the Board approve publication of the safety manual in installment form in the JOURNAL, with the understanding that, upon completion of the series, the installments will be combined into a single reprint offered for sale. [The Board approved.]

Report of the Audit of Association Funds

For the Year Ending December 31, 1954

To the Members of the American Water Works Association:

The By-Laws require that the Secretary have an audit made annually of the books of the Association.

The records for 1954 have been examined by the staff of Louis D. Blum & Co. The complete record of that examination follows.

Audits have been published in the JOURNAL annually. Since 1942 they have appeared in the March issue.

Respectfully submitted,

HARRY E. JORDAN
Secretary

January 24, 1955

TO THE AMERICAN WATER WORKS ASSOCIATION:

We have examined the balance sheet of the American Water Works Association as of December 31, 1954, and the related statements of income and surplus for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the accompanying balance sheet as of December 31, 1954, and the related statements of income and surplus present fairly the financial position of the American Water Works Association at that date and the results of its operations for the year then ended, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

(Signed)

LOUIS D. BLUM & CO.
Certified Public Accountants

EXHIBIT A—Balance Sheet

December 31, 1954

Assets

Cash in Banks and on Hand		$ 46,218.28
Accounts Receivable:		
Advertising—Journal	$ 4,876.75	
Reprints	300.52	
Manual—Water Quality and Treatment	24.00	
Sundry specifications	492.83	
Your Water Supply (booklet)	1,290.06	
The Story of Water Supply (booklet)	452.30	
Other	273.96	7,710.42
Prepaid Membership Dues in Other Associations		609.10
Accrued Interest on Bonds		411.29
Inventories:		
Paper stock	11,708.02	
Type metal	2,166.44	
Manual—Water Quality and Treatment	3,532.50	
Manual of Water Works Accounting	721.16	
Manual—Water Rates	123.24	
Sundry specifications	1,896.13	
Quest for Pure Water—Baker	1,339.01	
Survival and Retirement (book)	1,036.13	
Willing Water novelties	186.75	
Cumulative Index	144.00	
Your Water Supply (booklet)	94.99	
The Story of Water Supply (booklet)	12.40	
Back issues—Journals—Vol. 1–46, inclusive (45,984 copies)	—*	
Back issues—Proceedings—1881–1913, inclusive (248 copies)	—*	22,960.77
Office Equipment (less depreciation)		9,099.54
Investments at Cost (Schedule 1)		133,498.00
Deferred Expenses		4,092.79
Deposit—Airlines		425.00
Total Assets		$225,025.19

Liabilities and Surplus

Accounts Payable	$ 442.51
Membership Dues—Advance Payments	52,500.17
Unearned Subscriptions to Journal	5,499.51
Payable to American Water Works Association Pension System	20,000.00†
Reserve for Award Fund (McCord)	53.02
Senior Members Contributory Fund	1,495.20
Surplus, per Exhibit C	145,034.78
Total Liabilities and Surplus	$225,025.19

* Back issues of Journals and Proceedings are inventoried but no money values are assigned to them for balance sheet purposes inasmuch as the entire costs were charged off during the year of publication. The quantity shown is in accordance with a tabulation supplied by the Association's printer.

† Secured by assignment of the income of US Savings Bonds, Series G, and maturity redemption value of such bonds in the amount of $20,000.00.

EXHIBIT A, SCHEDULE 1—INVESTMENTS
DECEMBER 31, 1954

Description	Interest Rate %	Principal Amount	Cost	Quoted Market or Redemption Value Dec. 31, 1954
Foreign Securities:				
Province of Ontario	4	$ 1,000.00	$ 732.50	$ 1,112.50*
Dominion of Canada, 6th Victory Loan	3	2,000.00	2,000.00	2,092.50†
Hydro Electric Power Commission of Ontario	2.75	5,000.00	5,075.00	4,931.25†
Province of Ontario	3	2,000.00	2,022.50	2,065.00†
Hydro Electric Power Commission of Ontario	3	2,000.00	2,020.00	2,060.00†
Dominion of Canada, 9th Victory Loan	3	5,000.00	4,775.00	5,187.50†
United States Securities:				
US Savings Bonds, Series:				
G	2.5	10,000.00	10,000.00	9,790.00‡§
G	2.5	10,000.00	10,000.00	9,670.00‡§
G	2.5	5,000.00	5,000.00	4,960.00‡
G	2.5	2,000.00	2,000.00	1,958.00‡
G	2.5	10,000.00	10,000.00	9,760.00‡
G	2.5	3,000.00	3,000.00	2,919.00‡
G	2.5	10,000.00	10,000.00	9,670.00‡
G	2.5	2,000.00	2,000.00	1,934.00‡
G	2.5	5,000.00	5,000.00	4,820.00‡
G	2.5	2,000.00	2,000.00	1,928.00‡
G	2.5	7,500.00	7,500.00	7,162.50‡
G	2.5	2,500.00	2,500.00	2,367.50‡
G	2.5	1,000.00	1,000.00	948.00‡
K	2.76	5,000.00	5,000.00	4,925.00‡
K	2.76	2,000.00	2,000.00	1,984.00‡
US Treasury Bills		10,000.00	9,974.10	9,991.40
US Treasury Bills		30,000.00	29,898.90	29,933.70
			$133,498.00‖	$132,169.85‖

* This security is payable in United States funds.
† These securities are payable in Canadian funds. Market value represents value in New York in United States funds.
‡ These amounts represent redemption value on Dec. 31, 1954.
§ Redemption value and income of these securities assigned to American Water Works Association Pension System.
‖ In addition to the above, the Association owns one share of Seymour Water Co. 6 per cent preferred stock, par value $25. This share of stock was received as a contribution during 1954.

EXHIBIT B—STATEMENT OF INCOME AND EXPENSES
FOR THE YEAR ENDED DECEMBER 31, 1954

Operating Income:		
Annual dues	$102,282.11	
Advertising—Journal	100,951.25	
Advertising—Directory	4,801.50	
Subscriptions to Journal	7,511.25	
Convention—registration fees	17,261.50	
Convention—ticket sales	8,509.71	
Convention—other events	84.83	
Water and Sewage Works Manufacturers' Assn.	7,500.00	
Interest and dividends on investments	2,202.12	
Miscellaneous income	40.92	
TOTAL OPERATING INCOME (carried forward)		$251,145.19

TOTAL OPERATING INCOME (brought forward)		$251,145.19
Publication Income:		
Manual—Water Quality and Treatment	2,436.75	
One-half of profit from sales of Standard Methods (book)	2,027.96	
Manual of Water Works Accounting	263.95	
Manual—Water Rates	247.45	
Sundry specifications	9,914.33	
Proceedings and Journals	1,219.85	
Quest for Pure Water—Baker	341.00	
Survival and Retirement (book)	169.45	
Willing Water novelties	1,035.12	
Reprints	5,765.94	
Cumulative Index	52.20	
Membership certificates	114.80	
Manual of British Water Supply Practice	216.70	
What Price Water (booklet)	99.84	
Your Water Supply (booklet)	13,160.81	
The Story of Water Supply (booklet)	19,099.57	
TOTAL PUBLICATION INCOME		56,165.72
TOTAL INCOME (carried forward)		$307,310.91

Operating Expenses:		
Directors' and Executive Committee Meetings:		
Travel expense	$ 7,514.83	
Stenographic expense	291.20	$ 7,806.03
Administrative Expenses:		
Rent	10,000.00	
Office supplies and services	13,658.36	
Membership promotion	558.44	
Pension—Secretary Emeritus	2,500.00	
Contribution to pension system	5,502.70	
Legal and accounting expenses	792.00	
General and special travel	2,196.98	
Federal activities	1,915,93	37,124.41
Administrative Salaries		75,659.50
Committee Expense		615.34
Division and Section Expenses:		
Section—membership allotment	19,218.85	
Section—official travel	3,892.62	
Section—general expense	648.05	23,759.52
Journal:		
Printing	46,163.05	
Production	4,312.04	
Paper	15,206.96	
Abstractors	75.96	
Directory	9,035.88	74,793.89
OPERATING EXPENSES (carried forward)		$219,758.69

TOTAL INCOME (brought forward)			$307,310.91
OPERATING EXPENSES (brought forward)		$219,758.69	
Convention:			
General	$10,853.75		
Entertainment	14,516.01	25,369.76	
Membership Dues in Other Associations		1,734.77	
Depreciation of Office Equipment		1,601.49	
Miscellaneous Expenses		138.89	
TOTAL OPERATING EXPENSES		$248,603.60	
Cost of Publications Sold:			
Manual—Water Quality and Treatment	$ 1,216.90		
Standard Methods (book)	40.64		
Manual of Water Works Accounting	182.81		
Manual—Water Rates	470.86		
Sundry specifications	6,410.40		
Proceedings and Journals	3.45		
Quest for Pure Water—Baker	251.92		
Survival and Retirement (book)	163.08		
Willing Water novelties	1,041.55		
Reprints	4,674.79		
Cumulative Index	14.40		
Membership certificates	112.25		
Manual of British Water Supply Practice	217.00		
Your Water Supply (booklet)	8,999.32		
The Story of Water Supply (booklet)	10,144.89	33,944.26	
Development Activities:			
Public relations	4,527.60		
Research promotion	121.78		
Teachers' manual	403.35		
Employment survey	2,691.25	7,743.98	
TOTAL EXPENSES			290,291.84
Net Income for the Year (transferred to Exhibit C)			$ 17,019.07

EXHIBIT C—SURPLUS FOR THE YEAR ENDED DECEMBER 31, 1954

Balance, January 1, 1954	$128,646.71	
Add: Net income for the year, per Exhibit B	17,019.07	145,665.78
Deduct: Uncollectible accounts receivable included in advertising income of prior years		631.00
Balance, December 31, 1954, per Exhibit A		$145,034.78

American Water Works Association Pension System

BALANCE SHEET—DECEMBER 31, 1954

Assets

Cash in bank	$ 1,658.66
Accrued bond interest	584.25
Investments (Schedule 1)	89,000.00
TOTAL ASSETS	$91,242.91

Liabilities and Reserve for Future Benefits

Liability for refund of employees' contributions plus earned interest	$ 7,102.79
Reserve for future benefits	84,140.12
TOTAL LIABILITIES AND RESERVE	$91,242.91

STATEMENT OF RECEIPTS AND DISBURSEMENTS FOR THE YEAR 1954

Item	Cash	Reserve for Future Benefits	Liability for Refund of Employees' Contributions
Receipts:			
Association contributions	$5,502.70	$ 5,502.70	
Employees' contributions	1,708.99		$1,708.99
Interest on bonds	2,122.80	2,122.80	
Total	9,334.49	7,625.50	1,708.99
Disbursements:			
Investment in Series K bonds	9,000.00		
Refund of contributions plus interest	55.47		55.47
Audit and legal expense	50.00	50.00	
Office expenses	70.48	70.48	
Total	9,175.95	120.48	55.47
Excess of Cash Receipts Over Disbursements	158.54	7,505.02	1,653.52
Adjustments for Non-Cash Items:			
Interest credited to employees' accounts		(122.69)*	122.69
Interest accrued on bonds, Jan. 1, 1954		(554.35)*†	
Interest accrued on bonds, Dec. 31, 1954		584.25‡	
Total		(92.79)*	122.69
Additions to accounts for year	158.54	7,412.23	1,776.21
Balance, Jan. 1, 1954	1,500.12	76,727.89	5,326.58
Balance, Dec. 31, 1954	$1,658.66	$84,140.12	$7,102.79

* Deduction.
† Accrued interest receivable as per balance sheet Dec. 31, 1953.
‡ Accrued interest receivable as per balance sheet Dec. 31, 1954.

SCHEDULE 1—INVESTMENTS, DECEMBER 31, 1954

Description	Interest Rate %	Principal	Maturity Date
Bonds Registered in Name of Administrative Committee:			
Series G	2.5	$10,000.00*	1961
Series G	2.5	10,000.00*	1962
Series G	2.5	14,000.00*	1963
Series K	2.76	9,000.00*	1964
Series K	2.76	17,000.00*	1965
Series K	2.76	4,000.00*†	1966
Series K	2.76	2,000.00†‡	1966
Series K	2.76	3,000.00†§	1966
Bonds Registered in Name of Association and Assigned to Administrative Committee:			
Series G	2.5	10,000.00	1956
Series G	2.5	10,000.00	1958
		$89,000.00	

* Redemption value on Dec. 31, 1954: $61,765.00.
† Acquired in 1954.
‡ Not redeemable until Apr. 1, 1955.
§ Not redeemable until Jun. 1, 1955.

1954 Section Membership Awards

Old Oaken Bucket		Hill Cup		Henshaw Cup	
Section	Score*	Section	Score†	Section	Score‡
California	1,181	Pacific Northwest	45.645	Alabama-Mississippi	66.1
Southwest	889	California	29.375	Ohio	62.7
New York	800	Southeastern	24.242	Montana	61.8
Canadian	606	Kansas	22.200	Canadian	59.2
Illinois	495	Michigan	18.286	Rocky Mountain	58.8
Pennsylvania	467	New York	14.384	West Virginia	57.3
Pacific Northwest	437	Ohio	11.070	California	53.7
Ohio	434	Iowa	10.476	Illinois	49.4
New Jersey	422	Indiana	9.104	North Carolina	49.2
Michigan	384	Alabama-Mississippi	8.040	Indiana	48.8
Indiana	348	Montana	7.992	Iowa	45.8
Florida	316	Virginia	7.569	Kentucky-Tennessee	45.5
Southeastern	253	Canadian	7.440	Minnesota	44.8
Chesapeake	238	Missouri	7.060	Southeastern	44.7
Minnesota	232	Minnesota	5.742	Chesapeake	43.5
Kansas	216	Rocky Mountain	5.322	Michigan	43.5
New England	214	Kentucky-Tennessee	4.734	Kansas	42.7
Missouri	194	Florida	4.522	Virginia	41.5
Kentucky-Tennessee	188	Pennsylvania	3.280	Wisconsin	40.7
Alabama-Mississippi	182	Nebraska	2.141	Florida	37.3
Virginia	181	New Jersey	2.065	Pennsylvania	26.0
North Carolina	180	West Virginia	1.549	Southwest	23.0
Wisconsin	177	Illinois	1.292	Arizona	‖
Rocky Mountain	159	Arizona	§	Cuba	‖
Iowa	129	Chesapeake	§	Missouri	‖
West Virginia	97	Cuba	§	Nebraska	‖
Nebraska	92	New England	§	New England	‖
Arizona	70	North Carolina	§	New Jersey	‖
Cuba	57	Southwest	§	New York	‖
Montana	54	Wisconsin	§	Pacific Northwest	‖

* Number of members.
† Weighted gain in membership.
‡ Percentage of members present at annual meeting.
§ Minus score.
‖ Data not available or section not competing.

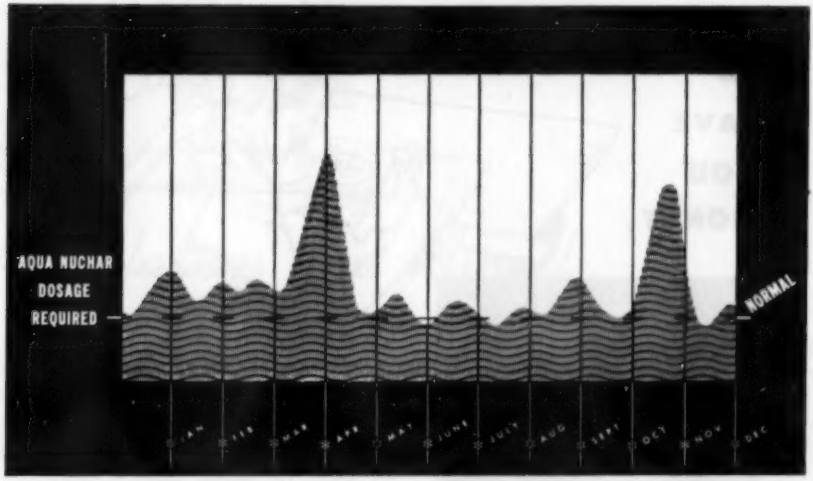
AWWA Membership Growth

Membership Statement—Year of 1954

	Active	Corporate	Munic. Serv. Subscriber	Associate	Honorary	Junior	Affiliate	Total
Total members, Dec. 31, 1953	7,922	866	189	355	39	40	49	9,460
Change of grade, 1954	4	−1	1	—	3	−6	−1	
	7,926	865	190	355	42	34	48	9,460
Gains:								
New, 1954	1,012	71	38	24	—	14	1	1,160
Reinstated, 1954	63	4	1	1	—	—	—	69
	9,001	940	229	380	42	48	49	10,689
Losses:								
Resignations and deaths, 1954	−231	−14	−5	−5	—	—	−1	−256
Dropped for nonpayment, 1954	−421	−45	−12	−6	—	−6	−3	−493
TOTAL MEMBERS, Dec. 31, 1954	8,349	881	212	369	42	42	45	9,940
Net gain in 1954	427	15	23	14	3	2	−4	480

Comparative Statement—Gains and Losses—25-Year Period

Year	New	Reinstated	Resignations and Deaths	Suspended for Nonpayment of Dues	Gain or Loss	Total Members at End of Year
1930	501	39	122	134	284+	2,831
1931	203	22	123	216	114−	2,717
1932	117	22	169	297	327−	2,390
1933	168	56	159	234	169−	2,221
1934	271	66	86	122	129+	2,350
1935	565	42	85	190	332+	2,682
1936	311	53	104	218	42+	2,724
1937	515	86	122	139	340+	3,064
1938	520	59	144	140	295+	3,359
1939	578	64	122	179	351+	3,710
1940	514	58	113	212	247+	3,957
1941	480	92	116	236	220+	4,177
1942	570	59	132	233	264+	4,441
1943	769	88	130	198	529+	4,970
1944	734	92	140	171	515+	5,485
1945	543	56	111	235	253+	5,738
1946	816	79	168	324	403+	6,141
1947	933	74	143	349	515+	6,656
1948	847	81	207	347	374+	7,030
1949	1,083	75	196	323	639+	7,669
1950	852	58	128	421	361+	8,070
1951	1,090	63	199	441	513+	8,583
1952	1,005	66	232	505	334+	8,917
1953	1,077	99	263	370	543+	9,460
1954	1,160	69	256	493	480+	9,940



PEAKS DON'T COUNT in your carbon budget

Whenever taste and odor increase in your water supply it is necessary to use more Aqua Nuchar Activated Carbon. Don't blame the Aqua Nuchar if your dosages are insufficient because it is always the same quality and will adsorb with its usual speed the objectionable algae and trade waste tastes and odors. In addition, constant dosages of Aqua Nuchar will serve as the foundation for a quick increase should a greater requirement arise. However, it must be remembered that when these sudden intensifications in taste are cured and required dosages fall back to normal. the amount of *extra* Aqua Nuchar added must be eliminated.

To show your water plant operators and superintendents the exact amounts of Aqua Nuchar Activated Carbon required, our experts from our Technical Service Department will give a complete Threshold Odor Survey without obligation. Furthermore, they will advise them how to use Aqua Nuchar Activated Carbon with other chemicals. To obtain the palatable water your consumers desire, Industrial is ready to assist.

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The Neptune Meter Company has adhered to this principle for over 50 years. During that time many improvements have been made to Trident meters. Yet none of these has affected the basic design of the meters. The oldest Trident can be modernized with new, improved Trident parts. Rebuilt or brand-new, Trident is still the finest meter you can buy. Ask your neighbor . . . or ask the Neptune representative next time he calls.

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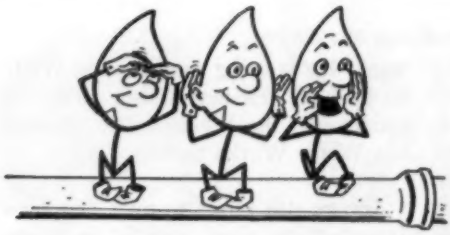


Percolation and Runoff

"Clean Water Means Better Health" is the theme of this year's World Health Day, to be celebrated April 7—the eighth birthday of the World Health Organization. And if waterborne disease seems so passé in this part of the world that the theme hardly needs singing, consider the virtue of pointing out to your customers that the great majority of the human race does not enjoy the benefits of a water supply whose safety is professionally overseen. The stated purpose of World Health Day is "to help stimulate understanding of the basic relationship between water resources, health, and civilization itself," something that every water worker ought to be selling not only on April 7, but every day.

Willing Water will be doing his part by taking *The Story of Water Supply* to our good neighbors of Latin and South America in Spanish and Portuguese. All you have to do is tell that story in English. And if you start your celebrating on March 29, you'll be honoring AWWA-day, too—74th birthday of water's own international safety council.

Vital statistics are getting more vital all the time as far as water works practice is concerned. In 1954, more than 4 million births and less than 1½ million deaths in the U.S. meant an additional demand of at least 375 mgd in terms of present per capita use. And with births increasing, the death rate dropping, and per capita use rising every year, it ought soon to be obvious that the situation isn't going to cure itself.

To feed the new mouths, science has pushed ahead on two new fronts: First, researchers at the University of California have just been successful in harnessing sunlight to create sugar and starch from carbon dioxide and water outside the living cells of green plants—a momentous discovery. Then, with a Rockefeller Foundation grant of $1,000,000, another branch of the same university is to begin an exploration of ocean resources with the purpose of increasing the proportion of marine food from its present measly 1 per cent. Meanwhile, to quench the new thirsts, science has been busy, too, with plans to harness not only the sun, but the atom as well. Sun saddler is a French engineer, M. Henri Coanda, who has suggested the use of low-cost parabolic mirrors for applying solar radiation to the evaporation of salt or brackish water to produce drinking and irrigation supplies. Apparently the solar mirrors, to be made of aluminum, will evaporate the water at a low temperature, producing fresh water at the rate of 200 liters per day per square meter (approximately 5 gpd per square

(*Continued on page 36 P&R*)

(Continued from page 35 P&R)

foot) of mirror, in addition to yielding valuable magnesium byproducts. Atomically, plans are being advanced toward the creation of a pilot plant, again at the University of California, to investigate the economic feasibility of using atomic energy to convert sea water to fresh water on a large enough scale to furnish municipal supplies. And the federal government has already invested more than a million dollars in the search for this and other means of making our oceans drinkable.

All this scientificating, of course, is just fine and dandy, but it hardly excuses the water works man from planning his future supply now on the basis of present practice and working as hard toward putting his plans into effect as if there were no oceans. After all, the University of California may have its brains knocked out in next year's Rose Bowl game.

Darling Valve & Mfg. Co. has opened a new sales office at 30 N. LaSalle St., Chicago. B. E. Engstrom will head the office as Midwest sales manager. Other changes announced by the company include the appointment of Lewis M. Poag as representative in the Cincinnati area; the transfer of B. F. Marcin, sales engineer, from New York to Pittsburgh; the appointment of Leon A. Hoffmeister as sales engineer in New Jersey and Delaware; and the appointment of Frank C. Zeis as representative in the St. Louis area.

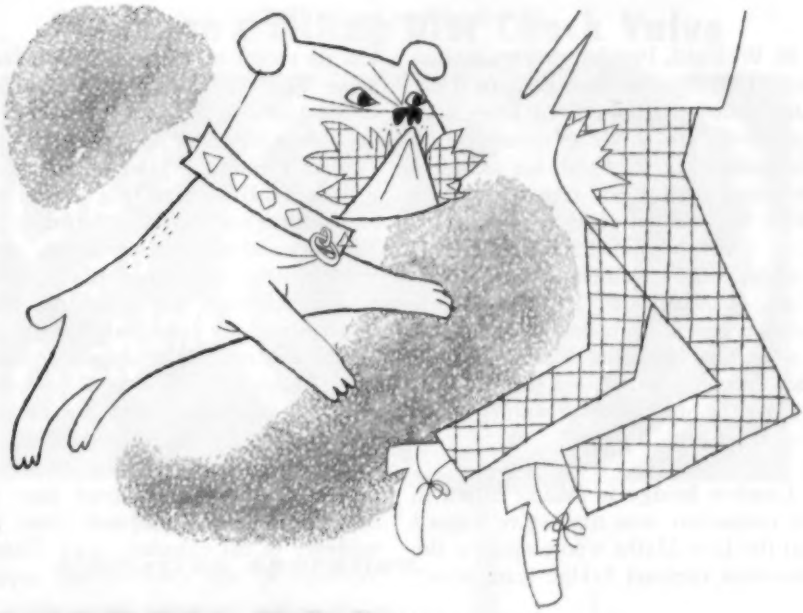
Robert S. Millar, long well known as manager of the Wichita Water Co., has resigned to accept the post of assistant manager for the Denver, Colo., Board of Water Commissioners. Always active in Association affairs, Millar has served as Kansas Section chairman. He is being succeeded in Wichita by J. W. Heiney, assistant division manager of the Western Div., American Water Works Service Co.

Jersey still refers to milk, but New Jersey, these days, strictly to water. As a matter of fact, if the water used in manufacturing the newsprint on which water stories were printed last year could be wrung out, the whole state would be flooded. Just the clippings provided by two resident Editors Anonymous from three or four local newspapers during 1954 weighed more than 5 lb. Not just quantity either, but quality news as well, that rated selection among the top ten stories of the year in the Ridgewood *Herald-News* as well as being the subject of one of its three best cartoons—a subject, moreover, that was keyed as THE problem for 1955 by the Newark *News*.

Still the major issue involved is more reservoir storage, particularly for the metropolitan north of the state, and that is to be the top item on the agenda of the State Legislature. It has been a top item, too, for the New Jersey Section and for such AWWA leaders in the state as Charlie Capen, Dick Bonyun, and Bill Orchard, all of whom have been laboring long and hard for an intelligent, far-seeing state water policy. What will come of the politickling between the Republican legislature and the Democratic governor, between the urban Northerners and the rural Southerners, is more than difficult to predict, but it is safe to say that the New Jersey public can't help but become water supply conscious in the process. And that, of course, is the only thing that can make attainable the end desired.

New Jerseyites could drink milk, but the Garden State needs watering.

(Continued on page 38 P&R)



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"The sign of value around the world"

(Continued from page 36 P&R)

H. W. Ford, Pittsburgh–Des Moines Steel Co. director and Eastern Dist. sales manager, has retired from both positions. He is being succeeded by his brother, C. R. Ford, his associate for many years. His retirement completes 42 years of service to the company, which he joined shortly after his graduation as a civil engineer from the Univ. of Michigan. In 1914 he became a sales engineer at the New York office, becoming New York district manager in 1929—a post he held for over a quarter of a century, until his retirement.

London bridge is falling down in our estimation, now that we've learned that the Lew Mathe who played on the American contract bridge team which lost its recent match to a British foursome was not actually "a technician in the Los Angeles Water Works," as had been reported in the New York *Herald Tribune*. Having been all set to hail the British players as real water crushers and having polished up our witticisms about getting above one's work during one's spare time, we now find ourself more than a little let down to have nothing to report but the defeat of a mere building appraiser in the Los Angeles Tax Assessor's office. If it was Lew who threw the *Tribune* reporter off in his identification, we certainly appreciate his vocational aspirations, but, having read into his most sensational bids and plays the evidence of his calculations of Hazen-Williams *C* and chlorine and copper

(Continued on page 40 P&R)

FOR MAKING SERVICE CONNECTIONS

Skinner Seal Service Saddle for steel, cast iron and transite pipe. Single massive bolt speeds and simplifies installation. Write today for new catalog.

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SOUTH BEND, INDIANA

GUNITE
PROTECTIVE COATING
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FROM MAINE TO FLORIDA

We offer the unique combination of engineering knowledge and practical field experience of a compact organization ready to function successfully in any part of the country as consultants, applicators, or subcontractors.

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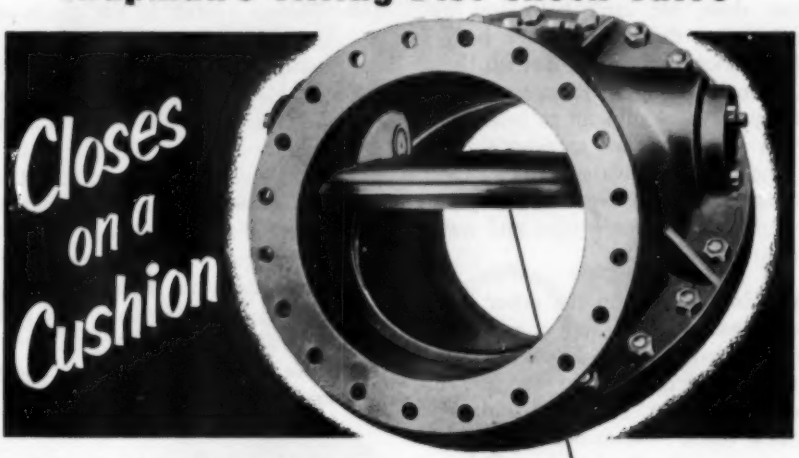
CHEMICAL Fire and RUST PROOFING corp.

11-33 31st Dr., Long Island City, N.Y.

Chapman's Tilting Disc Check Valve

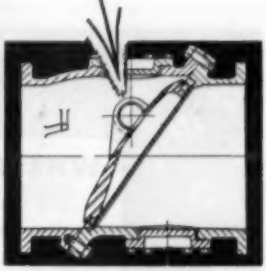


...for low cost, slam-free operation

Balanced pressures *cushion* the movement of the disc in Chapman's Tilting Disc Check Valve. The valve closes quickly but quietly, in all but unusual piping arrangements. There's no slamming to damage pipe-line joints or the valve itself. And *drop-tight* closure eliminates sliding wear on the disc and seat.

In the open position, the "airfoil" designed disc rides firmly against stops, without swinging or fluttering. That's why the hardened extra-large hinge pins give extremely long wear. And the absence of turbulence is one reason why head loss through Chapman's Tilting Disc Check Valve is lower than through any other type of check valve.

Low head loss, increased wear resistance and freedom from destructive slamming make Chapman's Tilting Disc Check Valves unbeatable for almost every installation. Write for Catalog No. 30 today.



Here's why CHAPMAN Tilting Disc Check Valves *Keep Quiet* All Their Lives

This specially designed "airfoil" disc balances perfectly in open position . . . then drops easily to closed position (cushioned by the flow). No jarring or slamming, in usual pipe-layouts. Write for bulletin.

THE CHAPMAN VALVE MANUFACTURING COMPANY
INDIAN ORCHARD, MASSACHUSETTS

(Continued from page 38 P&R)

sulfate dose, we can't help now but suppose that there must have been a water works man on the British team. On second thought, though, it may actually be more difficult to beat down a man from the tax assessor's office than one from the water works. Here it took just six clubs to do the job, leaving both London bridge and water at their usual levels.

London poker, on the other hand, seems to be building up, a recent report entitled "Royal Flush" actually featuring the fight of one David Millwood, commoner, to have installed in his new home "the same sort of toilet he says is used in Buckingham Palace." In fact, this latter-day David has already installed a flushometer w.c., but the Metropolitan Water Board has threatened to cut off his water supply if he doesn't switch to the chain-pull type promptly—laudably enough, to save water. Whether Millwood now has a flushless flushometer or a flushometerless flush is not known, but at last reports he was "asking only" that the Board "remove the ban or at least treat everyone alike," pointing out that not only the royal family's, but W.C.'s own w.c. at Chequers was provided with the urbane button rather than the churlish chain. His point, of course, is that, water shortage or no, even a full house of kings and queens doesn't measure up to a royal flush.

E. Arthur Bell, water superintendent and borough engineer for Essex Fells, N.J., since 1937, has resigned to accept the post of chief engineer for the Stamford (Conn.) Water Co.

(Continued on page 42 P&R)

WHEELER FILTER BOTTOMS
. . . give these outstanding plants—corrosion free construction • uniform flow distribution • low head loss.
CLEVELAND, OHIO (Havens & Emerson, Engrs.)
NASHVILLE, TENN. (The Chester Engineers)
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WILMINGTON, DEL. (Metcalf & Eddy, Engrs.)
For details on monolithic and pre-cast Wheeler Bottoms, write Builders-Providence, Inc., 365 Harris Avenue, Providence 1, Rhode Island.
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DIVISION OF B-I-F INDUSTRIES, INC.
BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • OMEGA MACHINE CO.
METERS
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CONTROLS

"Century" Pipe, 4" Class 150, ready for laying in trench in Oakland, Oklahoma.

SMOOTH BORE

"CENTURY" PIPE

The smooth bore of "Century" Asbestos-Cement Pipe means less resistance to water flow and, consequently, lower pumping costs. Formed on a smooth steel mandrel, the pipe has an interior surface to match. The Williams and Hazen Constant "C" is conservatively placed at 140 for "Century" Asbestos-Cement Pipe. Being non-metallic, it cannot tuberculate.

More and more cost and tax conscious communities are recognizing the economy of "Century" Pipe. We will gladly furnish information about its advantages. Write today for a copy of our free booklet, "Mains Without Maintenance."

QUALITIES THAT MAKE "CENTURY" PIPE ECONOMICAL, TROUBLE-FREE, LONG-LIVED

1. NON-TUBERCULATING
2. NON-CORROSIVE
3. EXCEPTIONALLY STRONG
4. DURABLE
5. IMMUNE TO ELECTROLYSIS
6. TIGHT JOINTS
7. SMOOTH BORE
8. EASILY, QUICKLY LAID
9. LIGHT WEIGHT
10. LOW COST

"Century" Pipe meets the A.W.W.A., A.S.T.M. and Federal Specifications for asbestos-cement pressure pipe.

KEASBEY & MATTISON COMPANY • AMBLER • PENNSYLVANIA

Nature made asbestos . . . Keasbey & Mattison has made it serve mankind since 1873.

(Continued from page 40 P&R)

William W. Brush, editor of "Water Works Engineering," received the Centennial Award of New York University's College of Engineering for "professional achievements and services to the common good." At left is Henry T. Heald, chancellor of the university; at right, Thorndike Saville, dean of the college of engineering. The presentation was made to 100 distinguished alumni on Jan. 29, to celebrate the college's 100th anniversary.

Remorse re Morse—Roy Morse, that is—has let up considerably with word of his appointment as director of the Department of Interior's technical review staff. But even that good news doesn't make any less unfortunate his ouster as superintendent of the Seattle, Wash., Water Dept. in favor of a strictly political appointee from the mayor's staff. Happy as we are to see Roy in a bigger and better job than he left, we hate to think that his good work both in administering the Seattle department and in building for its future is now to be undone. Not only we and he, either, but the City Council as well, and particularly the chairman of the Council's utility committee, who has not only objected to the mayor's appointee, but demanded Roy's reappointment. With two Washingtons calling, it will be D.C. now, at least until the Seattle job opens again in another four years.

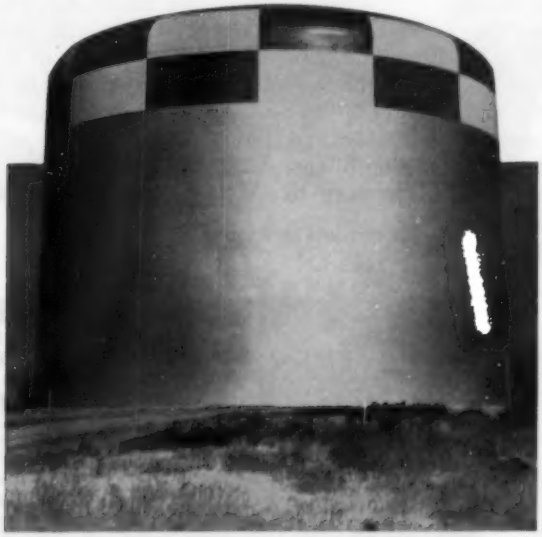
Price reductions averaging 9 per cent over the level established in 1950 have been announced by Automatic Control Co. of St. Paul. Product simplifications, improvements, and advances in engineering and manufacturing techniques have made the reductions possible.

(Continued on page 44 P&R)

Specify "ROSS" AUTOMATIC VALVES

FOLLOW THE LEAD OF THE ENGINEERS WHO SPECIFIED CONTROLS FOR THIS STANDPIPE FOR THE "SOUTH PITTSBURGH WATER CO.," PITTSBURGH, PA.

WATER LEVEL IN THIS "AMERICA'S LARGEST" STANDPIPE IS CONTROLLED BY A 20-inch ROSS DOUBLE ACTING ALTITUDE VALVE.



Pioneers in the manufacture of automatic hydraulic control valves. Ross has served the industry since 1879.

— *Valves manufactured* —

ALTITUDE—BACK PRESSURE—FLOAT PRESSURE REDUCING — SURGE RELIEF — COMBINATION WITH HYDRAULIC AND ELECTRIC PILOT CONTROLS

ROSS VALVE MANUFACTURING CO., INC.

P. O. Box 593 Troy, N. Y.

(Continued from page 42 P&R)

Slightly disguised, as shown herewith, Willing Water crashed the ladies' program at last October's Alabama-Mississippi Section meeting and really had a time for himself. Making his first appearance on the invitation stationery, he really followed through in making faces on the ladies' badges, on their napkins at a morning coffee party, on their place cards at luncheon, and, giving even the boys a break, on the banquet place cards as well. Originally designed as a decoration for the Birmingham Water Works Board employee magazine by the secretary to General Manager W. H. H. Putnam, these wee willies were put to work by Section Chairman Putnam's other boss in her capacity as chief of ladies' events. All of them made a big hit with those in attendance, and even with us after it was explained that calling him a "drip" and allowing him to get through to the public in an unhappy condition was part of the disguise.

Harry Lundquist's retirement as Neptune Meter Co. representative in Minnesota and the Dakotas has been made the occasion of a special resolution of appreciation by the South Dakota Water & Sewage Works Conference. He had been with the firm for 27 years, and with the Thomson Meter Co. for 3 years before that.

(Continued on page 46 P&R)

Each length of pipe we manufacture passes through the above hydrostatic test press where it is filled with water and the pressure raised to 500 pounds per square inch. The most common water works pipe is designed for an operating pressure of 150 pounds per square inch. This undergoes the 500 pounds per square inch hydrostatic test and permanent records for each piece of pipe are kept on file for inspection by our customers at all times. You can be assured with Alabama's Super De Lavaud Cast Iron Pipe. In sizes of 3" to 24" in modern long lengths. Bell and Spigot, Mechanical Joint and Flanged Pipe.

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ALABAMA PIPE COMPANY
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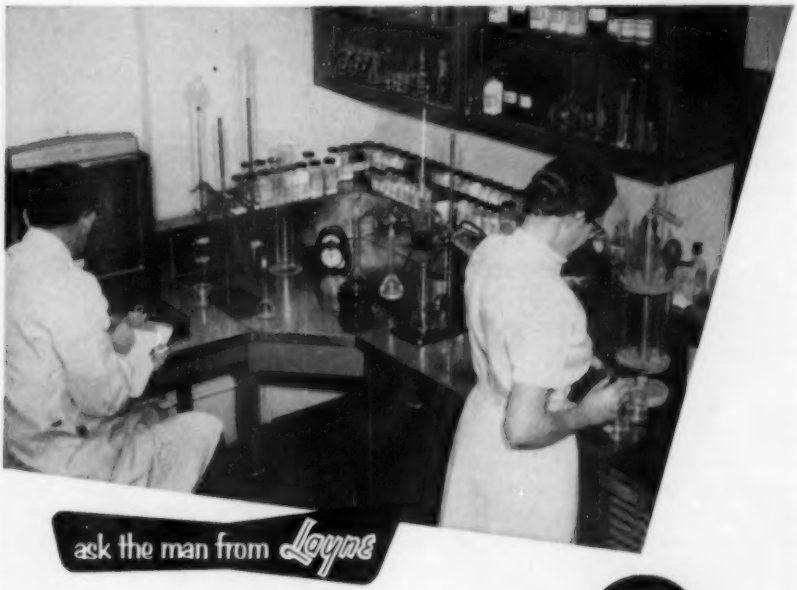

Research that serves ...and Saves!

Ever continuing research constantly seeking new and better methods and materials has helped keep Layne in its acknowledged position of industry leadership.

Municipalities, small and large, have and are endorsing that leadership by their preference for Layne pumps and wells.

On any question relating to water, it is wise first to "ask the man from Layne."

LAYNE & BOWLER, INC.

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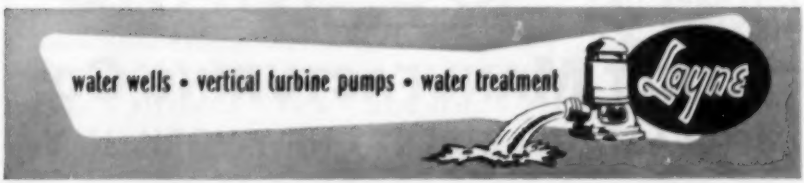
Layne Associate Companies Throughout the World



(Continued from page 44 P&R)

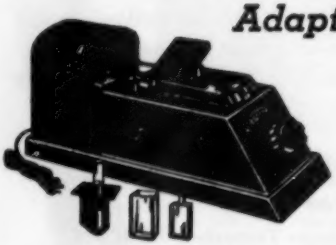
Rainmaking 1954 seemed to have less than the usual amount of nonscience to it. As a matter of fact, everyone seemed so completely in agreement about the basic soundness of weather modification principles and the tremendous promise of weather control procedures that the whole subject has come to be too cut and dried for P&R taste. Latest evidence of this dignification has been the formal investigation launched by the President's Advisory Committee on Weather Control "to evaluate weather control experiments on a methodical, nationwide basis." This survey, headed by Committee Chairman Howard T. Orville, a former Navy captain who was weather adviser to the Secretary of the Navy during World War II, is being made on the basis of the detailed monthly reports submitted by 25 persons and companies engaged in the weather modification business in various parts of the US. Its outcome, in addition to a conclusion that weather control is an entirely practicable procedure, will probably be some form of federal control to protect the poor man who moved to an arid area because his corns hurt when it rained.

More than just this federal ferreting has provided proof of the new place of the rainmaker in the everyday world. No longer do the news stories about him carry hoaxish headlines, no longer are the reports prefaced with minimifidian quips. The theory that dust from outer space may be a natural cloud-seeding device, the report that

(Continued on page 48 P&R)

KLETT SUMMERSON
ELECTRIC PHOTOMETER

Adaptable for Use in Water Analysis



Can be used for any determination in which color or turbidity can be developed in proportion to substance to be determined

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179 EAST 87th STREET · NEW YORK, N. Y.

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What you see here is routine procedure on raw materials coming to Crane. There's no unloading of the more than 3,000 incoming carloads per year until the Crane Quality Control Lab gives an unqualified O.K.

The extra care that Crane gives to raw materials, and similarly to every step in manufacturing, pays off in better valves for you. You can be sure that Crane stands for quality that results in lower cost in the long run.

That's another reason why thrifty buyers prefer Crane valves. They know they're investing in better piping performance as well as protecting against untimely and excessive maintenance. A mighty important consideration in these days of high costs. And, surely, the main reason why industry keeps using more Crane valves than any other make.

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VALVES • FITTINGS • PIPE • KITCHENS • PLUMBING • HEATING

CRANE'S FIRST CENTURY . . . 1855-1955

(Continued from page 46 P&R)

farmers at Longkloof on the eastern cape of South Africa dissipate hail clouds that threaten their crops by firing rockets loaded with silver iodide into them, the news that UN technicians have been able to increase rainfall in the Punjab some 50 per cent at a cost of about $30,000,000 for 2,000 sq miles by the use of hand blowers to disperse salt-particle seeds, even word that someone sabotaged Laguna Beach's rainmaking machine, are all now given serious treatment in the press. And such popular magazines as *Collier's* and the *Farm Journal*, as well as many of the Sunday supplements, are featuring reviews of rainmaking accomplishments and speculation concerning its future to bring this new gift of Science to the man on the street. Even the man who can afford to get off the street and into a theater won't necessarily escape it, now that N. Richard Nash's romantic play, *The Rainmaker*, which makes a legitimate "hero" out of one of them, can be considered a hit.

We're buying an umbrella!

A series of changes in Worthington Corp. management has resulted in the election of Hobart C. Ramsey, president, to the post of chairman of the board, He suceeds Howard Bruce, who became Executive Committee chairman and remains chief executive officer. Edwin J. Schwanhausser is the new president, Walther H. Feldmann the new executive vice-president, and William A. Meiter the new general sales manager, succeeding Thomas J. Kehane, the new vice-president in charge of sales.

(Continued on page 82 P&R)

WHY USE JOHNSON WELL SCREENS?

1. **Less drawdown.**
2. **Greater specific capacity.**
3. **Lowest pumping cost per million gallons of water.**

True economy is measured not by first cost alone, but in lowest yearly cost. The JOHNSON WELL SCREEN combines an unmatched record of experience and dependability with greatest strength and durability. It is the finest and most truly economical well screen in the world.

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Norfolk Prefers Concrete Pressure Pipe

Since 1921, Norfolk, Virginia, has been specifying concrete pressure pipe for its water supply and distribution system. Over 450,000 feet of pipe is now in use. Diameters range from 20″ to 48″.

Still in excellent condition is the 31,700 feet of concrete pressure pipe laid in 1921. There has been no necessity to take this pipeline out of service for any maintenance work; nor has the pipeline suffered from any trouble due to electrolytic action. This pipe is now carrying water at the same high capacity as when it was installed.

If your city wants pipe with an assured high-carrying capacity, decade after decade... if long term economy is a necessity . . . then look into the advantages of concrete pressure pipe when you plan your next transmission or distribution lines.

Member companies manufacture concrete pressure pipe in accordance with nationally recognized specifications

Concrete PRESSURE Pipe

WATER FOR GENERATIONS TO COME

AMERICAN CONCRETE PRESSURE PIPE ASSOCIATION
228 North LaSalle Street
Chicago 1, Illinois

The Reading Meter

Sun, Sea and Sky: *Weather in our world and in our lives. Irving P. Krick & Roscoe Fleming. J. B. Lippincott Co., East Washington Sq., Philadelphia 5, Pa. (1954) 248 pp.; $3.95*

Dr. Krick proceeds on the fruitful assumption that weather forecasting can be a science rather than an art because of the "great principle that in the atmosphere nothing happens by chance; all is rigidly logical and can be traced, if our knowledge and skill are sufficient." As a result, he uses a sort of analog indexing system to find weather maps in the past that match those of today, with—he tells us—excellent results for his predictions. Dr. Krick is better known to JOURNAL readers as the cloud-seeder and rainmaker, and this book does not neglect his excursions into weather modification. It also contains many choice accounts of military and other events in which weather and the knowledge of weather played a significant part, and a general review of the history of weather study and the way in which weather "happens."

Water Quality Criteria: Addendum No. 1. *Pub. 3, Addendum 1, State Water Pollution Control Board, Rm. 610, 721 Capitol Ave., Sacramento 14, Calif. (1954) 164 pp.; paperbound; $1.50*

This addendum to the 1952 report on Water Quality Criteria (see September 1953 JOURNAL, p. 54 P&R), which was designed to aid enforcement of California's Water Pollution Control Act of 1949, was also prepared by Jack E. McKee. The general intent was to bring up to date the literature study embodied in the original report, and it is planned to issue future supplements at intervals of two or three years. The report adopts the useful arrangement of indexing various constituents of natural or polluted waters alphabetically, discussing briefly the literature dealing with the permissible concentrations and effects of each. A reference list of 371 items and a survey of quality standards adopted by other state and basin agencies are included.

Pocket Book of Chemical Technology. *V. Stannett & L. Mitlin. Chemical Pub. Co., 212—5th Ave., New York 10, N.Y. (1954) 283 pp.; $4.75*

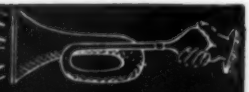
Not to be confused with the "Pocket Books" of the newsstands, this handy little compilation of facts and figures offers a tremendous amount of information in a small space. Some spottiness of coverage is to be expected, and may be attributed to the editors' attempt to hold this one reference work down to the size implied by its title by concentrating on essentials. What it does offer, however, appears not only useful but clearly and logically presented.

Clarke's Tables and Memoranda. *Philip Honey & W. J. Woolgar, ed. B. T. Batsford, Ltd., 4 Fitzhardinge St., London W.1, England (10th ed., 1954) 400 pp.; $1.25 US*

Subtitled "A Pocket Compendium of Technical Data for the use of plumbers, builders, sanitary, heating, and electrical engineers, etc.," this useful reference work is the first handbook this department has ever seen which actually fits the hand, measuring about $3 \times 4\frac{1}{4}$ in. The information provided includes data on the amount of yarning and lead required to calk pipe of various sizes; dimensions, weights, and test pressures for various pipes and tubings; and similar items. Some of these presuppose British standards of construction, of course, but other information—such as the rate of flow required to flush out various

(*Continued on page 52 P&R*)

YOU WERE DOING THIS



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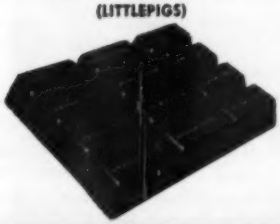

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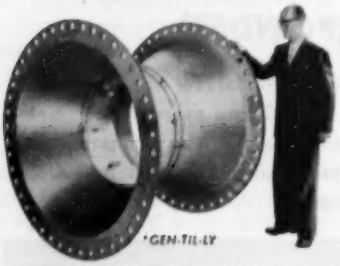
measures flow in either direction



*GEN-TIL-LY

REVERSIBLE . . . The Flow Tube is symmetrical, with upstream and downstream ports identical. When the flow is reversed, the differential is reversed. Permits metering reverse flow at lowest possible equipment cost.

LOW INSTALLED COST . . . Average length is only 1½ times the pipe diameter, and straight runs entering and following are not required unless installed near throttling valves or regulators.

ACCURACY . . . Produces differential from points of equal cross-sectional area . . . furnished with head capacity curves, and guaranteed for exceptional accuracy when used with any standard indicating, recording or integrating meter.

LOWEST HEAD LOSS . . . The Flow Tube can be designed to produce a measurable differential with the lowest permanent pressure loss of *any* type head meter.

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AUTOMATIC VALVES
SAFETY VALVES FLOW TUBES

The Reading Meter

(Continued from page 50 P&R)

building materials or rubble—is more nearly universal.

The Technical Report: *Its preparation, processing, and use in industry and government. B. H. Weil, ed. Reinhold Pub. Corp., 430 Park Ave., New York 22, N.Y. (1954) 485 pp.; $12*

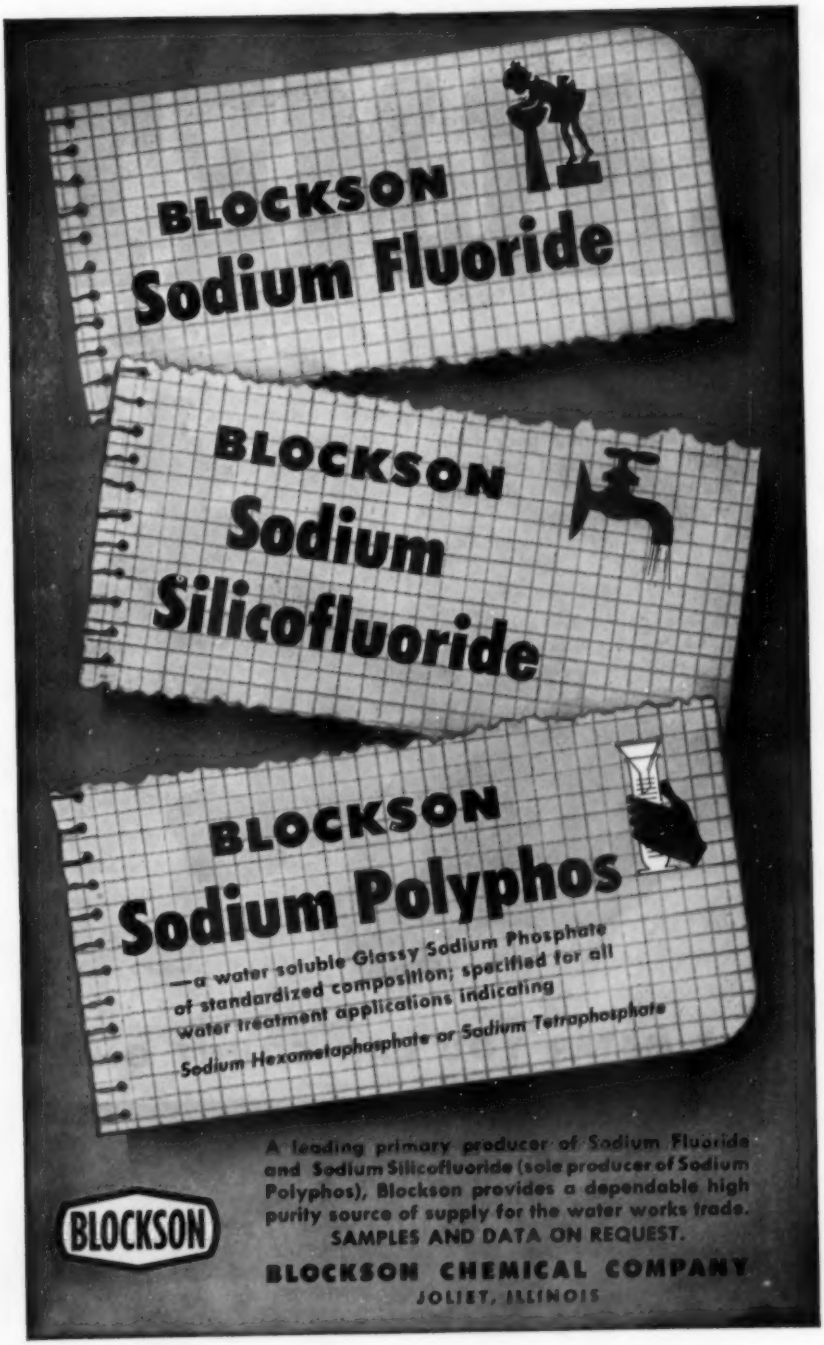
Approximately two dozen contributing authors have assembled a wealth of usable information on the writing, editing, illustrating, duplicating, and distributing of the industrial or governmental technical report. Thorough coverage of all procedures considered plus discussions of such subjects as indexing and using reports makes the book an especially useful one for all report writers, editors, librarians, and even readers.

Treatment of Water for Land Boilers—B.S. 2486:1954. *British Standards Institution, London (1954) 38 pp.; paperbound; $0.95 from American Standards Assn., 70 E. 45th St., New York 17, N.Y.*

This British Standard is intended as a companion volume to B.S. 1170 on marine boilers. Discussions of boiler maintenance, internal and external treatment, and testing are given in some detail. Useful appendixes provide a glossary of water treatment terms, a discussion of water softening reactions, and a conversion table that relates six different methods of expressing water hardness.

Methods of Sampling & Testing Boiler Water Deposits—B.S. 2455: 1954. *British Standards Institution, London (1954) 45 pp.; paperbound; $0.95 from American Standards Assn., 70 E. 45th St., New York 17, N.Y.*

This addition to the small library of British Standards on boilers includes standards for sampling, preparation for analysis, the analysis itself, and the reporting of results. Methods for quantitative, qualitative, and physical analysis are given.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Key: In the reference to the publication in which the abstracted article appears, 39:473 (May '47) indicates volume 39, page 473, issue dated May 1947. If the publication is paged by the issue, 39:5:1 (May '47) indicates volume 39, number 5, page 1, issue dated May 1947. Abbreviations following an abstract indicate that it was taken, by permission, from one of the following periodicals: *BH—Bulletin of Hygiene (Great Britain); CA—Chemical Abstracts; Corr.—Corrosion; IM—Institute of Metals (Great Britain); PHEA—Public Health Engineering Abstracts; SIW—Sewage and Industrial Wastes; WPA—Water Pollution Abstracts (Great Britain).*

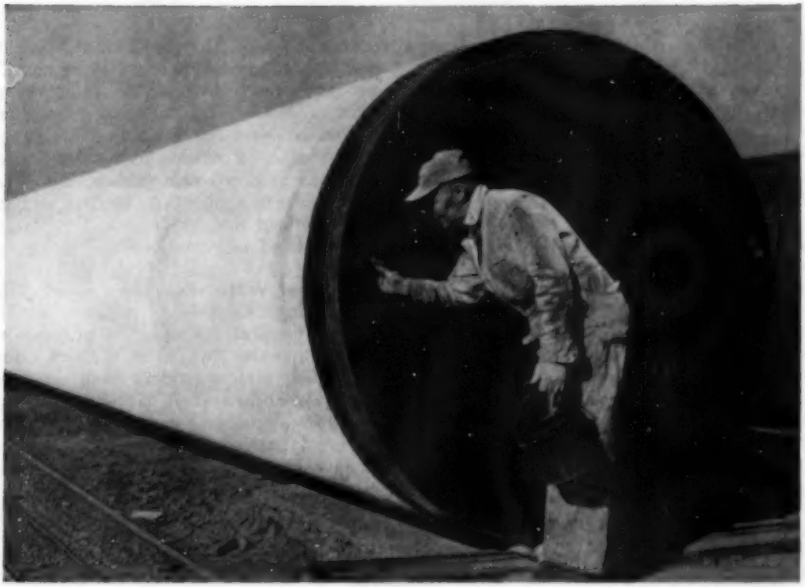
CANADIAN WATER SUPPLIES —GENERAL

Municipal Cooperation in Water Supply Exemplified by Burlington-Nelson, Ont. B. J. HENDERSON. Munic. Util. (Can.), 92: 8:28 ('54). Since establishment of Burlington-Nelson Interurban Bd. in '47, customers have increased 100% and yearly increase is continuing at rate of 20%. Prior to '47, Burlington system consisted of intake and filter plant valued at about $500,000, and Nelson Twp. purchased treated water from that system. With creation of Bd., all appurtenances and mains pooled, as was also $226,000 debenture debt of Burlington. Within few months, East Flamborough Twp. admitted to scheme, surcharge of $5 per house per yr. being added to rates to compensate for nonassumption of portion of debt. Total area served 16 sq mi, pop. about 20,000. Supply works in '48 included 16" intake in L. Ontario, 3 rapid sand filters, low- and high-lift pumps. Filter plant since increased to 3-mgd capac. by addn. of 4 units, and 20" intake installed to replace 16" intake destroyed by ice. New 36" intake, extending 2,300' into 30' of water, under constr. Treatment plant comprises chem. feeders for alum, ferric chloride, and carbon; vortex-flow mixing chambers; stilling chamber with 1 wall perforated with 1" holes through which water flows into settling basins; and 7 filters contg. 27" gravel and 27" anthracite, underdrains being of Wheeler type. Two high-level districts, el 300' above plant, supplied by 2 automatic booster stations. Distr. storage includes 1.25-mil gal reservoir, 0.2-mil gal standpipe, and recently completed 0.8-mil gal reservoir. Latter may be increased to 30 mil gal. Filter plant extension contemplated. Consumption has not increased in direct proportion to customers, probably owing to increase in labor-saving devices in homes. Close watch kept for leakage: good results obtained with geophone and subsequent night flow observations where leakage indicated.—*R. E. Thompson*

Metro Water, Sewerage Extensions Projected by Consulting Engineers [Toronto, Ont.]. ANON. Eng. Cont. Rec. (Can.), 67:3:106 ('54). Recommendations for municipality of Metropolitan Toronto include: [1] L. Ontario main source of supply; [2] other sources, mainly wells, ultimately to be abandoned; [3] Toronto Island plants not to be extended; [4] western portion to be supplied from New Toronto plant, eastern from Scarborough, rest from Toronto plants; [5] Scarborough plant to be enlarged immediately; [6] new intake pipe from outer end of existing intake tunnel and enlargement of R. C. Harris Purification Plant from 100 to 200 mgd; [7] rehabilitation and addnl. pumping capac. at John St. high-lift sta.; [8] covering of open Rosehill Res. and increase in capac. from 35 to 50 mil gal; [9] addnl. ground reservoirs, preferably adjacent to areas to be supplied; [10] completion of Parkdale high-lift sta. and extension of high-level sta.; [11] large feeder mains to be laid; [12] uniform standards for mains, hydrants, valves, etc., throughout metropolitan area. With exception of Toronto and New Toronto, practically all services in metropolitan area now metered. Estd. cost of universal metering $6,000,000. In view of heavy capital program and fact that waste not excessive, universal metering may be deferred for some time, although need for it is more and more apparent.—*R. E. Thompson*

Buffalo Pound Lake Huge Water Supply Project [Sask.]. A. SHATTUCK. Eng. Cont. Rec. 67:12:64 ('54). Undertaking which will supply Regina, and eventually Moose Jaw, from South Saskatchewan River approaching completion. Regina consumption in '53 5.6 mgd (80 gpcd), which will probably increase to 90 when supply ade-

(*Continued on page 64*)



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(Continued from page 62)

quate. Estd. safe yield from present sources 5.35 mgd; 4.0 from Boggy Creek and 1.35 from Mound Springs. Mallory field, yielding 0.75 mgd, will be abandoned. Headworks designed for 24-mgd ultimate capac.; 37-mi pipeline to city for 20 mgd; and pumping and filter plant for initial capac. of 6 mgd. Intake, 54″-diam. asbestos-bonded corrugated pipe, terminates 800′ from shore in 11′ of water, 90-deg elbow being encased in 20′-square block of concrete and protected by steel cover 15″ above latter, providing max. entrance velocity of 0.5 fps at 24 mgd. Two low-lift pumps, vertical deep well turbines, 4- and 6-mgd capac., resp., controlled from filter plant 2 mi south. Pipeline to latter 42″ diam., static lift 280′. Filter plant includes flash mix; 2 upflow conditioning units, 20′ deep, equipped with recirculating pump (4 times capac. of units) and sludge scrapers; and 4 1.5-mgd filters designed to operate at 2 US gpm/sq ft. Latter contain Miller block underdrains, Palmer agitators, 5 layers of gravel, and 26″ sand obtained and screened locally. Backwash rate 24 gpm vertical rise. One 6-mgd horizontal centrifugal pump to deliver water to city; provision for 2 addnl. units. Pump for delivering water to storage tanks for wash water can be utilized for pumping to city also. Provision for use of activated silica as reqd. 3 chlorinators, with choice of 3 points of application: to flash mix tank, filter influent line, or clear well. Softening contemplated ultimately.—*R. E. Thompson*

Municipal Water Supplies. L. B. Thomson. Eng. Cont. Rec. (Can.), **67**:11:78 ('54). General discussion of progress with regard to water supplies in Western Canada. Since '35, prairie farmers have constructed over 51,000 individual farm water storage projects. In addn., over 450 water storage projects have been constructed on community basis for agricultural purposes. Federal govt., through Prairie Farms Rehabilitation Administration, has provided engineering and financial assistance, latter amounting to approx. ⅓ of cost. This work has led to demand on farms and in urban

(Continued on page 66)

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(Continued from page 64)

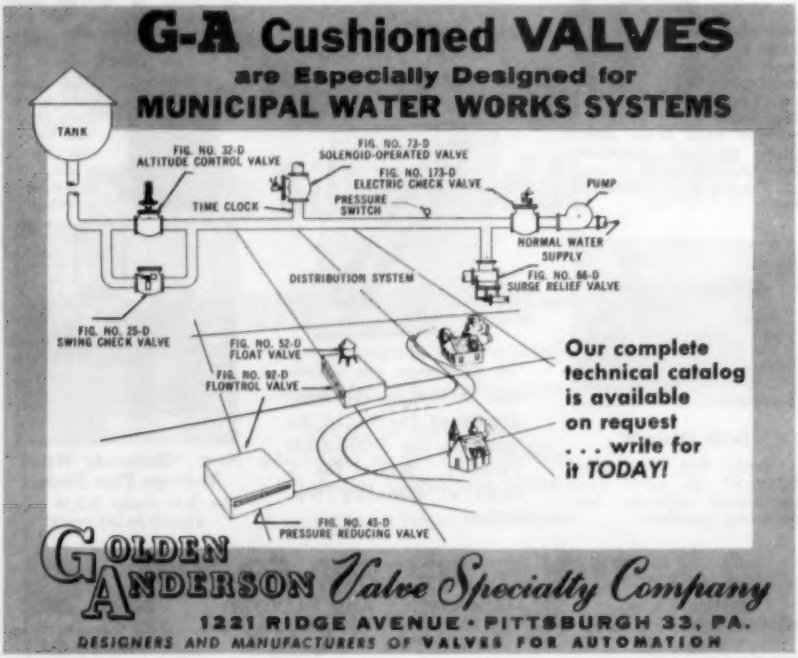
centers for domestic supplies and sewage disposal, and to vast improvement in living conditions. Examples of how small towns have been transformed by provision of water supplies included.—*R. E. Thompson*

ANNUAL REPORTS

Community: **Pasadena, Calif.**
Reporting organzation: Water Dept.
Year ending: Jun. 30, '52
Population served: 126,700
Customers: 37,577
Source of supply: surface and well water
Water produced (mil gal): 8,062
Water sold (mil gal): 7,515
Water unaccounted for (%): 6.7
Metered services (%): 99
Mains (mi): distr. and trans.: 414
Valves: 4,606
Hydrants: 2,152
Distr. storage (mil gal): 104.28
Revenue ($): water: 1,875,253; other: 261,435; total: 2,136,688
Expense ($): 1,551,814
Income ($): 584,874
Bond interest ($): 189,790
Bond retirement ($): 180,000
Paid to general fund ($): 97,137.50
Book value ($): 7,251,516
Debt outstanding ($): 3,864,000
Water analysis: range of various sources (ppm): silica: 11.0–33.1; iron: 0.02–0.12; calcium: 19.2–46.2; magnesium: 2.9–14.6; sodium and potassum: 11.6–185.0; carbonates: 0.0–6.3; bicarbonates: 103–213; sulfates 12.5–283; chlorides: 6.8–87.0; total alky.: 85–175; total hardness: 64–175
Rates: inside city: $1.50 first 500 cu ft to $30.00 first 14,000 cu ft; outside city: $1.81 first 500 cu ft to $37.50 first 14,000 cu ft.

Community: **Jacksonville, Fla.**
Reporting organization: financial report covering all city depts.
Year ending: Dec. 31, '52
Population served: 204,517
Customers: 54,726
Water produced (mil gal): 10,618

(Continued on page 70)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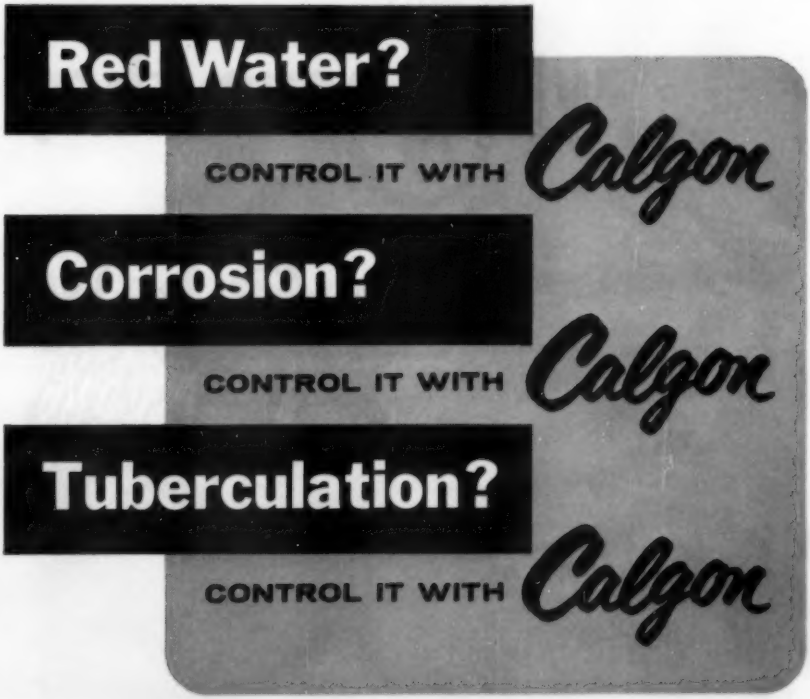

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what have they

The rhino lives in wooded, watery districts of Africa and Asia. Its temper is short, its eyesight dim but its scent and hearing are very acute. Though heavy, it is extremely fleet of foot. It feeds mostly at night and its diet is largely vegetarian.

This cast iron main laid in Richmond in 1830 is still functioning after more than a century of service.

MODERNIZED **cast iron**

in common...

THE RHINO AND CAST IRON PIPE...TOUGHNESS!

The thick, tough hide of the rhinoceros makes it one of the hardest animals to bring down. Toughness is also a dominant feature of CAST IRON PIPE. It serves for centuries.

AND HERE'S PROOF! Listed below are some of the many water utilities still using cast iron pipe that was installed a century or more ago.

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ALEXANDRIA WATER COMPANY Alexandria, Virginia
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DEPARTMENT OF PUBLIC WORKS, DIVISION OF WATER, Buffalo, N. Y.
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COLUMBIA WATER COMPANY Columbia, Pennsylvania
BOARD OF WATER COMMISSIONERS Detroit, Michigan
CITY OF FREDERICK WATER DEPT. Frederick, Maryland
PUBLIC SERVICE COMMISSION City of Halifax, N.S., Public Water Supply
WATER BUREAU OF THE METROPOLITAN DISTRICT, Hartford, Connecticut
MUNICIPAL WATER WORKS Huntsville, Alabama
BUREAU OF WATER Lancaster, Pennsylvania
CITY OF LYNCHBURG WATER DEPARTMENT, Lynchburg, Virginia
MOBILE WATER WORKS COMPANY Mobile, Alabama
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TODAY... modernized cast iron pipe, centrifugally cast, is even tougher, stronger, more uniform. *Where needed and specified*, it is centrifugally lined with cement mortar to assure sustained carrying capacity throughout its long years of service.

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CAST IRON

The G-Check stenciled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.

pipe FOR MODERN WATER WORKS OPERATION

(Continued from page 66)

Revenue ($): water: 1,561,780; other: 53,534; total: 1,615,314
Expense ($): maint.: 947,118; depn.: 82,-412; total: 1,029,530
Income ($): 585,784
Bond interest ($): 112,125
Bond retirement ($): 100,000
Added to reserve ($): 320,647
Paid to general fund ($): 26,135
Book value ($): 11,598,072
Debt outstanding ($): 4,900,000
Unit costs: water ($/mil gal): 0.27; power and pumping ($/mil gal): 2.94; purif. ($/mil gal): 0.14; trans. and distr. ($/mil gal): 3.43; customer acctg. and collecting ($/mil gal): 1.38; admin. and general ($/mil gal): 0.76.

Community: **Dubuque, Iowa**
Reporting organization: Water Dept.
9 mo ending: Dec. 31, '51
Population served: 47,527
Source of supply: wells
Type of treatment: fluoridation only
Water produced (mil gal): 1,706
Water sold (mil gal): 1,278
Water unaccounted for (%): 10.93
Consumption (mgd): avg: 6 (120 gpcd)
Mains (mi): distr. and trans.: 131
Valves: 2,549
Hydrants: 1,003
Distr. storage (mil gal): 12.18
Revenue ($): water: 224,202; other: 1,458; total: 225,660
Expense ($): op.: 103,760; maint.: 21,853; depn.: 33,189; total: 158,802
Income ($): 66,858
Bond interest ($): 1,876
Book value ($): 2,371,914
Debt outstanding ($): 100,000
Unit costs: power ($/mil gal): 27.00
Rates (¢/100 cu ft): 7–27; minimum quarterly charge: $2.45.

Community: **Augusta, Me.**
Reporting organization: Water Dist.
Year ending: Dec. 31, '52
Population served: 20,000
Customers: 4,376
Source of supply: Carleton Pond

(Continued on page 72)

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All bronze case from 2" to 6"

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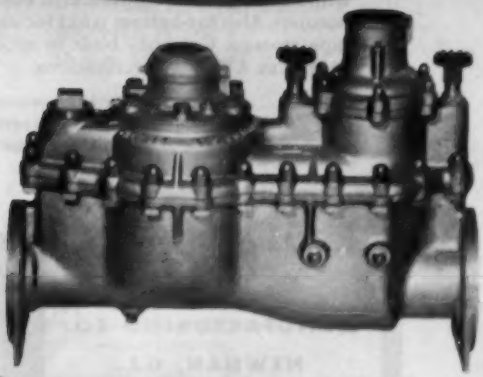

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BRANCH OFFICES: NEW YORK — PORTLAND, ORE. — PHILADELPHIA — ATLANTA — DALLAS — CHICAGO — SAN FRANCISCO — LOS ANGELES

(Continued from page 70)

Type of treatment: chlorine and lime
Water produced (mil gal): 1,100
Consumption (mgd): max.: 5.0; avg: 3.0 (150 gpcd)
Main (mi): distr. and trans.: 82.5
Valves: 894
Hydrants: 307
Distr. storage (mil gal): 16.0
Revenue ($): 143,137
Expense ($): op. and maint.: 57,766; depn.: 42,587; other: 868; total: 101,221
Tax paid (% of revenue): 0.6
Income ($): 41,915
Bond interest ($): 12,801
Bond retirement ($): 25,000
Debt outstanding ($): 381,500
Unit costs: power ($/mil gal): 6.50; chemicals ($/mil gal): 1.40
Other items: short-wave 2-way radio communication installed in office and 3 vehicles during past year.

Community: **Scarsdale, N.Y.**
Reporting organization: village manager
Year ending: Apr. 30, '52
Population served: 13,600
Customers: 4,123
Source of supply: Pocantico Lake (New Rochelle Water Co.) and New York City Catskill Aqueduct and Bronx Pipeline
Water produced (mil gal): 651
Water sold (mil gal): 565
Water unaccounted for (%): 13.2
Consumption (mgd): avg: 1.8 (132 gpcd)
Main (mi): distr. and trans.: 87.8
Hydrants: 788
Revenue ($): water: 167,723; other: 48,433; total: 216,156
Expense ($): 149,820
Income ($): 66,336
Bond interest ($): 6,913
Bond retirement ($): 22,750
Capital outlay ($): 26,749
Debt outstanding ($): 145,750
Unit costs: water ($/mil gal): 102; pumping ($/mil gal): 11.50; purif. ($/mil gal): 0.90; trans. and distr. ($/mil gal): 19; customers' acctg. ($/mil gal): 18; admin. and general ($/mil gal): 77
Rates: ($/1,000 cu ft); 2.05 plus service charge of 50¢ per quarter for ¾" meter.

(Continued on page 74)

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For almost a century Cole elevated tanks have been helping provide uniform water pressure, fire protection and adequate water reserve in scores of American cities.

Capacities 5,000 to 2,000,000 gallons—with hemispherical, ellipsoidal or conical bottoms. Also flat-bottom tanks for standpipe storage. Correctly built in accordance with AWWA specifications.

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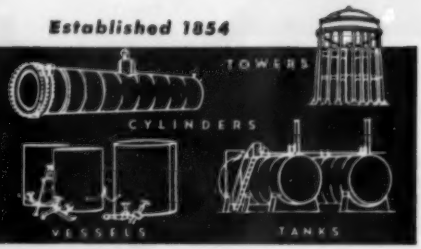

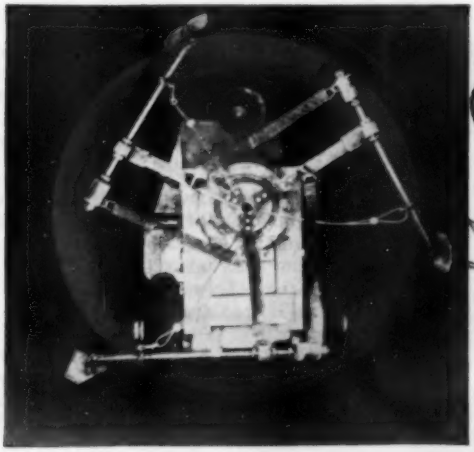

CENTRILINE goes to CUBA

The Centriline process has been selected by Municipio de la Habana to play an integral part in the expansion of this city's water supply system. Over 114,000 feet of new welded steel pipe, ranging in diameters from 30" to 78", will be cement-mortar lined in the near future.

In this process, the novel machine illustrated above is drawn through the pipe while cement-mortar is centrifugally sprayed on the pipe walls and troweled smooth by the rotating arms. Mortar thickness is controlled by the speed of the entire machine. Because the pipes remain in place throughout the process, traffic interruption is cut to a minimum; time and money are saved.

Whether you're expanding or rejuvenating your water system, follow the lead of progressive city officials and engineers around the world. Call on Centriline to add years of new life to your water supply lines.

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• CEMENT-MORTAR LINING OF PIPES IN PLACE •

(*Continued from page 72*)

CHEMICAL ANALYSIS

Electrochemical Determination of Dissolved Oxygen of Surface Waters. F. Todt, W. Schwarz, & H. G. Todt. Gesundh.-Ing. (Ger.), **75**:224 ('54). Effects of electrolyte concn., hardness, surface area, and type of electrodes on measurement of DO diffusion current are described. Upper limiting values for extensively applicable standard curve are represented by 200 ppm as NaCl, 360 ppm $CaCO_3$ hardness, and about 0.1-sq cm electrodes, when these are noble-mental amalgams. This method is very rapid and can be used for continuous-recording purposes.—*M. Suter*

Spectrophotometric Determination of Small Amounts of Oxygen in Waters. T. C. J. Ovenston & J. H. E. Watson. Analyst (Br.), **79**:383 ('54). Method for detg. 0.001–0.1 ml of DO in boiler feedwaters is based on procedure recommended by Bairstow and colleagues, but precision is improved by avoiding use of starch and by detg. liberated I by ultraviolet absorption of the I_3^- ion. Procedure has also been simplified by elimination of step involving volumetric diln. before photometric measurement. —*CA*

The Molybdenum Blue Reaction and the Determination of Phosphorus in Waters Containing Arsenic, Silicon, and Germanium. H. Levine, J. J. Rowe & F. S. Grimaldi. Science, **119**:327 ('54). $Al(OH)_3$ is pptd. from natural waters to carry down $AlPO_4$. Ppt. is treated with soln. of HF, HBr, HCl, and H_2SO_4 to volatilize any copptd. As, Ge, or Si. Phosphate is then detd. by molybdenum blue reaction. P_2O_5 content in Gulf of Mexico ranged from 1.8 to 5.9×10^{-4} %.—*CA*

Determination of Silica in Water by Aluminum Hydroxide. M. Akahane & C. Tanaka. J. Chem. Soc. Japan, Pure Chem. Sec., **75**:140 ('54). Add $AlCl_3$ or sulfate in amt. 10 times wt. of silica to sam-

(*Continued on page 76*)

BUILDERS PROPELOFLO is an inexpensive main line meter for totalizing water consumption. Gives dependable, trouble-free service on the job. Meters accurately over wide range — six-digit totalizer shows water use directly in gallons, cubic feet, etc. For complete information on this easy-to-install meter, write to Builders-Providence, Inc., 365 Harris Ave., Providence 1, Rhode Island.

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Supplied with the sleeve are split end-gaskets, split glands or follower rings, and longitudinal gaskets. Installation consists simply of placing the two halves of the sleeve and accessories around a broken pipe and bolting tight the joints. The longitudinal gaskets of the sleeve fit against the end gaskets, making a water-tight rubber seal. End gaskets are supplied to fit Classes AB or CD pit cast pipe, or Classes 100, 150, 200 and 250 centrifugally cast pipe. Available in sizes 4-inch to 16-inch.

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(*Continued from page 74*)

ple soln., add mixt. of NH_4OH and NH_4Cl to sample until pink to phenolphthalein, again add Al, and repeat addn. of ammonia to pH 8.5 ± 0.2. After ppt. settles, det. silica in supernatant colorimetrically. If its amt. is large, repeat pptn. Sep. ppts. of $Al(OH)_3$ by centrifuging, and dissolve in $2N$ HCl. Det. silica in this soln. gravimetrically in usual way.—*CA*

Determining the Total Salts and the Sulfate Ion in Natural Waters by the Conductivity Method. N. I. Vorob'ev. Gidrokhim. Materialy, Akad. Nauk USSR, **21**:121 ('53). Assumption is made that cond. of water is detd. primarily by Ca, Mg, Na, K, Cl, SO_4, HCO_3, and CO_3 ions in pH ranges 5.5–9.0. From table on cond. of NaCl/l (resistance of concns. of salt from 2.0 to 4.4 meq with increments of 0.01 meq), quantity of total salts in water examd. is taken as first approximation. Bicarbonates and chlorides are detd. by titration, and difference between total salts (meq) and those of bicarbonates and chlorides represents first approximation of sulfates. To get more exact value for 3 respective salts (chlorides, bicarbonates, and sulfates) correction coeffs. are introduced. These coeffs. are made up in form of nomogram. Avg. cond. values of mixts. of chlorides, sulfates, bicarbonates, and nitrates in concn. of 1–10 meq (obtained from physicochem. tables of consts.) are calcd. by means of following formula: $\Delta sr = A\Delta a + B + \Delta b + C\Delta c/100$, where A, B, C = content of chlorides, sulfates, and bicarbonates in equivalent %, Δa, Δb, Δc = equiv. cond. of these ions, and Δsr = avg. value of equiv. cond. of mixt. of these salts. Correction coeff. $K = \Delta NaCl/\Delta sr$, where $\Delta NaCl$ is value of elec. cond. of NaCl, as given in table mentioned above. With values of coeffs. on nomogram, corrections are made in figures of first approximation. In general, this method is considered very reliable and accurate.—*CA*

The Influence of Ammonium Salts on the Determination of Zinc in Drinking Water by the Potassium Thiocyanate Method.

(*Continued on page 78*)

Limitorque® VALVE OPERATORS

Type SM with Worm Gear Drive on R-S Butterfly Valve.

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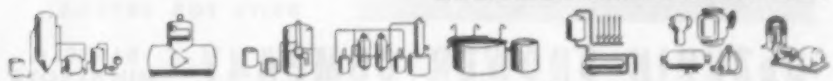
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(*Continued from page 76*)

A. PETZOLD. Wasserwirtschaft Tech., **3**:467 ('53). Method involves taking 100-ml sample, acidifying with 2 ml 25% H_2SO_4, adding 1 ml 5% $K_4Fe(CN)_6$, and shaking. Turbidity develops within 1 min, and nephelometric comparison is made with standard solutions similarly treated. 1 ppm Zn gives slight opalescence and 5 ppm yields heavy turbidity. Author found that, with H_2SO_4 used for acidification, Zn determinations were high, particularly if NH_3 had been used previously to ppt. Fe. Addition of H_2SO_4 resulted in considerable $(NH_4)_2SO_4$ being formed. Several series were set up, first with excess $(NH_4)_2SO_4$, then excess NH_4Cl, and finally with 0–14 ppm Fe. In series containing Fe, removal of Fe was effected by ammoniation followed by filtration. All series were acidified by H_2SO_4, and Zn was estd. nephelometrically. Entire series was repeated by using HCl for acidification. When H_2SO_4 was used, results were consistently high. In control samples at neutral pH with added $(NH_4)_2SO_4$ and NH_4Cl, Zn determinations were again high. However, when samples were acidified with 2 ml concentrated HCl/100-ml sample, results were very close to theoretical despite added NH_4 salts.—*CA*

Water Analysis by Complex-Ion Methods. G. GAD & E. FURSTENAU. Gesundh.-Ing. (Ger.), **74**:199 ('53). Disodium ethylenediaminetetraacetate (**I**) (Complexon III) is complexing agent for total hardness, Ca^{++}, and Mg^{++}. Murexide (**II**) is specific reagent for Ca^{++}. To det. total hardness, take 100-ml sample and titrate to methyl orange endpoint with 0.1*N* HCl. 1 ml HCl is equal to 2.8° carbonate hardness (German units). Add 0.5 ml 0.1*N* HCl and boil off CO_2. Cool to 50° and add 5 ml buffer (**III**) (54 g NH_4Cl + 350 ml 25% NH_3 in 1 l), and 1 ml Eriochrome Black T (**IV**) (0.2 g + 0.5 ml 25% NH_3 made up to 100 ml). Titrate at once with soln. (**V**) made up with 6.65 g **I** + 5.0 g Mg-Complexon III in 1 l. Color change is from red to pure blue. 1 ml of

(*Continued on page 80*)

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NON-LUBRICATED
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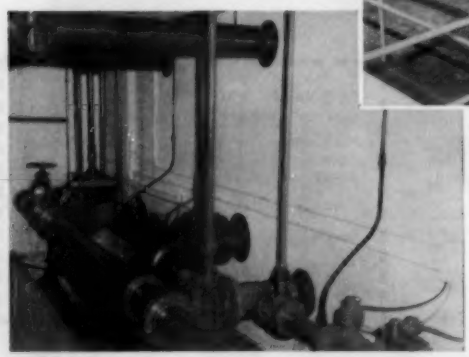

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Four sizes cover the range from 2½" to 12"

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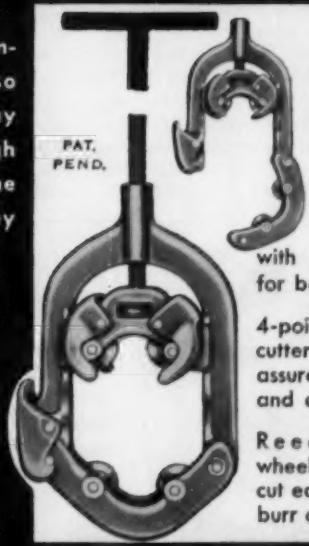

Four wheel design requires minimum swing of handle—less digging in ditch work, easier "tight-corner" cuts.

Closed frame permits light weight with complete rigidity for better cutting.

4-point guide aligns the cutter on the pipe . . . assures perfect tracking and a right angle cut.

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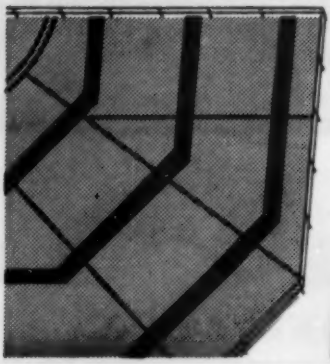
(*Continued from page 78*)

titrant equals one German degree of hardness (1 part CaO in 100,000 parts water). To det. Ca and Mg, take 100-ml sample and titrate alky. with 0.1*N* HCl with 0.2 ml Tashiro's indicator (15 ml 0.1% aq. methylene blue + 100 ml 0.03% alc. methyl red soln.) to prevent interference of methyl orange. Add 0.5 ml HCl in excess and boil off CO_2. Cool to 50°, adjust pH with NaOH to 12–13, add 1 ml satd. aq. soln. of murexide, and titrate with **I** (6.65 g in 1 l). Color change is from red to blue-violet. 1 ml titrant equals 1 mg CaO. Acidify sample with 0.5 ml 25% HCl and heat to 80° to destroy murexide. When pure red color of Tashiro's indicator is observed, add 5 ml **III** and 1 ml 25% NH_3. pH should be approx. 10. Add 1 ml **IV** and titrate at 40–50° with **V**. Color change is from red to pure blue. 1 ml **V** equals 0.719 mg MgO. Comparisons made of total hardness by palmitate method and complex method, and Ca and Mg by complex and gravimetric methods, indicate good agreement. Advantages of complex methods are speed and simplicity. Samples with very high hardness need not be dild.—*CA*

The Complexometric Determination of the Hardness Formers of Water. A. Smola & G. Hofbauer. Mitt. Chem. Forsch.-Inst. Wirtsch. Österr. (Austria), **8**: 12 ('54). Methods for detg. hardness formers of water are critically discussed and sepn. of Ca and Mg and detn. of total hardness described. In complexometric detn., water is first adjusted to pH 10 by addn. of buffer soln. and indicator added which at once produces wine-red color. At first all Ca is bound in complex form, and subsequently, Mg ions; e.g., Ca as oxalate, Mg as pyrophosphate. End of titration (by color change) does not depend on temp. between 10° and 60°, except that it takes longer at 10°. Disturbing influence of metal ions, Cu, Fe, Al, Mn, Ni, and Co, is eliminated before titration by addn. of cryst. Na sulfide. Some reagents specifically developed for these detns. are given, and results of measurements on water supply of Vienna are described in detail.—*CA*

This is the experience of a plant with a rated capacity of 20 m.g.d. river water (high mine waste content.) N-Sol® Activated Silica used with alum produces large, highly active floc that enmeshes suspended matter and settles rapidly. Thus, longer filter runs can be obtained.

N-Sol Activated Silica Sol increases filter runs 35%



N-Sol is prepared in your plant with N® Sodium Silicate (Na_2O:3.22SiO_2) and a reacting chemical.

Ask for sample of N® and information on various N-Sol Processes. No charge for license under our N-Sol patents.

Philadelphia Quartz Company
1142 Public Ledger Bldg., Philadelphia 6, Pa.

N-Sol® Processes
PQ® SOLUBLE SILICATES

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100th Anniversary Catalog

Now—one of the most comprehensive catalogs ever published in the industry. Completely new from cover to cover. 148 pages showing the Greenberg line in its entirety—new items, new illustrations, detailed descriptions, specification's and list prices. A must for the catalog library of every Engineer, Architect, Purchasing Agent, Pipe, Valve, Fitting and Plumbing Jobber. Write for your copy today!

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Manufacturers of: Underwriters Approved fire hydrants, hose valves and siamese connections. Fire protection hose goods; industrial, Navy and maritime bronze valves and fittings; plumbing and hardware brass specialties; bronze plaques, letters and name plates; crematory and cemetery bronze products.

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Gentlemen: Please send me a copy of your new catalog.

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By _____

If additional copies are desired, please list name and title of person to receive catalog.

(Continued from page 48 P&R)

Dorr-Oliver Inc. has centralized divisional sales headquarters at Stamford, Conn. (Barry Place); Chicago, Ill. (Merchandise Mart); and Oakland, Calif. (2900 Glascock St.). Transferred to Stamford is the Eastern Industrial Div., formerly at Wilmington, and the Eastern Filtration Div., from New York. The Evanston headquarters of the Central Sanitary Div. moves to Chicago. Finally, the Denver office of the Western Industrial Div. and the Los Angeles office of the Western Sanitary Div. are now located in Oakland.

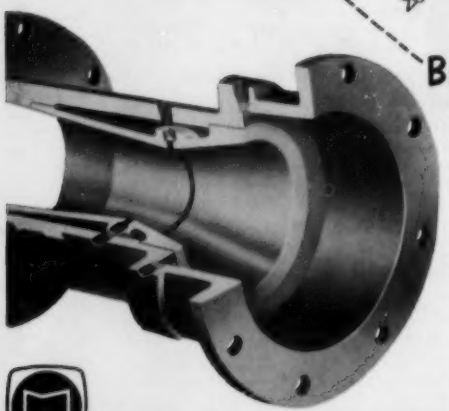
The Drilling Muds Div. of H. C. Spinks Clay Co. is being expanded to meet increased demands for Gleason, Spink-O, and Spink Gel drilling muds. A national network of dealers and distributors is being established for the purpose.

Big Brother of 1954 sounds frighteningly close to Big Brother of *1984*, but sound, happily, is where the resemblance ends, for AWWA member C. S. Mott, who received that title and a citation from President Eisenhower last month, earned his honor in just the kind of work that can prevent George Orwell's predicted society from befalling us. Mr. Mott, whose water works activities stem from his ownership of the St. Louis County Water Co., Independence Water Co., Gary-Hobart Water Corp., Long Island Water Corp., and a number of other water utilities, does his Big Brothering

(Continued on page 84 P&R)

When To Use

Builders Dall Flow Tubes



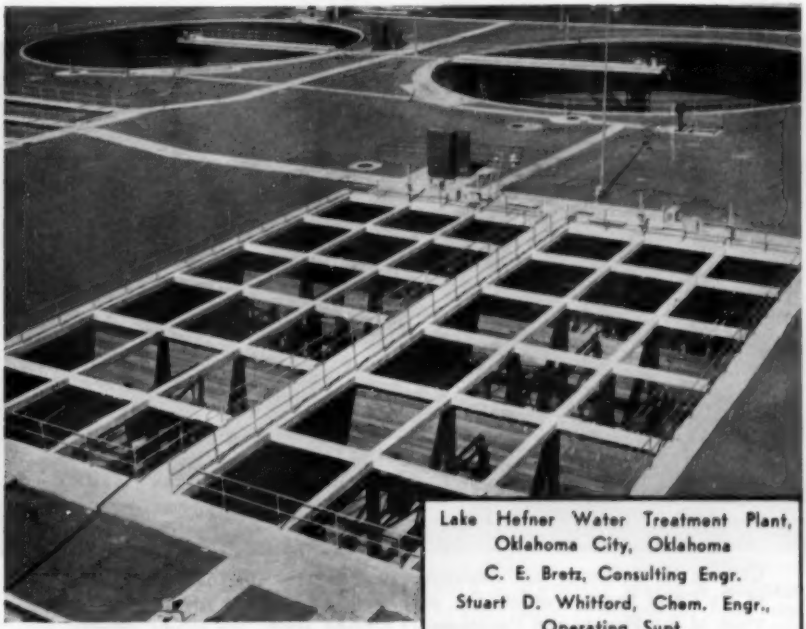
- Use Dall Tubes when you need compact, minimum-cost installations: (average laying length only 1½ times line size).
- Use Dall Tubes when you need sustained metering accuracy: (smooth tapered throat is self-scouring, dimensionally stable).
- Use Dall Tubes when you can't afford head loss: (highest pressure recovery of any velocity-increasing differential producer).
- For complete details write for Bulletin 115-L1. Builders-Providence, Inc., 365 Harris Ave., Providence 1, R. I.

BUILDERS-PROVIDENCE

DIVISION OF B-I-F INDUSTRIES, INC.

BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • OMEGA MACHINE CO.

BIF METERS FEEDERS CONTROLS



Lake Hefner Water Treatment Plant, Oklahoma City, Oklahoma

C. E. Bretz, Consulting Engr.

Stuart D. Whitford, Chem. Engr., Operating Supt.

Thirty-six paddle flocculation units installed in 2 tanks each 92'x36'x14'. Two pier supported center drive circular collectors in 100' diameter tanks.

WALKER EQUIPMENT

at Lake Hefner Water Treatment Plant

At Oklahoma City flocculation and sludge removal are effectively accomplished through the application of thoroughly engineered and ruggedly built Walker Process equipment.

Walker Process offers engineering and manufacturing experience with equipment to perform all water treatment processes including iron and manganese removal, mixing, softening, turbidity removal and carbonation.

Call upon Walker Process for recommendations and assistance on your next water treatment project.

WALKER PROCESS

WALKER PROCESS EQUIPMENT, INC.

Factory — Engineering Offices — Laboratories

Aurora, Illinois

(Continued from page 82 P&R)

Charles E. Coleman, left, assistant chief engineer of the Pump Dept. of De Laval Steam Turbine Co., and Leslie D. Quigley (center), supervisor of the Pumps and Compressors Design Dept., are shown displaying the watches presented to them for over 40 years' service by James P. Stewart, president of the company.

around his home town of Flint, Mich., through the Flint Youth Bureau, which is credited with having done a most effective job in reducing juvenile delinquency in the city.

Robert M. Gwynne has been appointed Los Angeles sales engineer of B-I-F Pacific.

Bucking up was the Chicago Sanitary District last month upon receipt of a postcard from nine-year-old David Pyle of Muskegon, Mich. And the buck that was up was one that had been offered way back in 1887 by the district's predecessor—the Drainage and Water Supply Commission. It was the commission's engineers, conducting a study of Lake Michigan currents, who dumped a lot of bottles into the lake at that time, each enclosing an addressed postcard which promised a dollar to the finder who mailed the card back with information on where the bottle was found. The study had, of course, been completed for almost 68 years when Davey found his bottle on the lake shore near his Muskegon home and hurried the reward card along to Chicago, but it would have been taking a bottle from a baby to have pointed that out. Instead, District President Anthony A. Olis invited the boy to Chicago to receive an 1899 silver certificate, the nearest thing to an 1887 buck available in the local coin shops. At that, the dollar, the luncheon, and the trip probably don't add up to too much more than the comparative purchasing power of the dollar back in 1887 when it was offered. Which is to point out that the buck that was up is considerably down—the currency having strayed just about as far as the current.

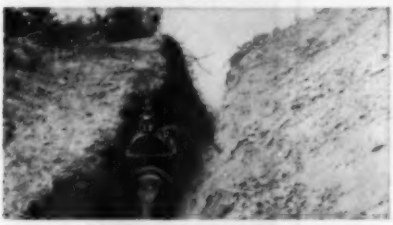
(Continued on page 86 P&R)

BRING ON YOUR RIVERS!

CLOW RIVER-CROSSING CAST IRON PIPE TAKES 'EM "IN STRIDE"!

EASY TO LAY. As easy to make up as a standard flanged joint. Lower labor installation cost because of ease of joint make-up and longer laying lengths.

ONLY A RATCHET WRENCH NEEDED. No split parts. Fewer parts—each joint consisting of one complete pipe, one solid follower ring, one solid ring gasket, bolts and nuts.



FULL 15° TURNING DEFLECTION with absolutely no reduction in the full internal opening area—therefore, no abnormal pressure-drops at deflected joints. Deflection stresses evenly distributed among all the bolts.

LONGER LAYING LENGTHS—approximately 18'6"—faster installation, lower costs. However, lengths may be varied to suit conditions. For example: 6 foot, 12 foot or other special lengths may be advisable to suit required curvature.

Mail coupon for complete information on Clow Ball-and-Socket River-Crossing Pipe. No obligation, naturally.

JAMES B. CLOW & SONS
201-299 North Talman Avenue
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Subsidiaries:
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Iowa Valve Co., Oskaloosa, Iowa

JAMES B. CLOW & SONS
201-299 North Talman Avenue
Chicago 80, Illinois

Please send me, without obligation, details and specifications of Clow Ball-and-Socket River-Crossing Pipe.

Company_____
Street Address_____
City_____ **Zone**____ **State**____
Individual's Name_____
Position_____

(Continued from page 84 P&R)

Charles B. Burdick, partner in the firm of Alvord, Burdick & Howson, consulting engineers of Chicago, long an Honorary Member of AWWA, died on Feb. 17, after a very brief illness. He had been in excellent health until a week before his death.

Mr. Burdick, who was born in Chicago, on Mar. 6, 1874, also centered his entire professional career there, following his graduation from the University of Illinois in 1895, but his practice was nationwide. To hydraulic and sanitary engineering, his contributions have been considerable. The original Niagara Falls filtration plant, which was built on his design some 43 years ago, was one of the first to demonstrate the effectiveness of filtration in reducing the incidence of typhoid, by successfully treating a water contaminated by the sewage of Buffalo, about 20 miles upstream. His office designed more than 100 filtration plants, including some of the largest in the world.

Throughout his engineering practice Mr. Burdick was a stickler for sound engineering analysis of the requirements and thorough study of solutions economically designed to satisfy those requirements. He carried his realistic economic thinking into practice, and the balance sheets of the municipal water supply with which he had long been connected reflect the soundness of his advice.

Mr. Burdick's development of the fundamental principles involved in the collection of underground water, as illustrated by the country's largest infiltration gallery installation at Des Moines, Iowa, has been a marked contribution. His studies of floods, their occurrence and their control, made him an outstanding authority on this subject as well.

Although economics entered strongly into all of Mr. Burdick's thinking, he did not permit it to dim his appreciation of "the finer things." That is, perhaps, best illustrated by Buckingham Fountain on Chicago's lake front, for which he designed the hydraulic and lighting features. The attractiveness of the structures and grounds of his many designs also gives proof of this esthetic appreciation.

A member of AWWA since 1907, and an Honorary Member since 1944, Mr. Burdick was the author of many JOURNAL contributions. He was an Honorary Member, too, of the American Society of Civil Engineers, the Western Society of Engineers, and the Chicago Engineers Club.

Moses N. Baker (above), the dean of water works authors and editors, and an Honorary Member of AWWA, died on Feb. 6 at his home in Upper Montclair, N.J. He was 91.

For 45 years—from 1887 to 1932—he had edited *Engineering News* and *Engineering News-Record.* From this observation post he collected the data which formed the subject matter for *The Manual of American Water Works,* a statistical and descriptive

(Continued on page 88 P&R)

For Beauty and Economy in Waterworks Structures...

Architectural Concrete

Marion L. Crist & Associates, architects and engineers. Peterson & MacFayden, contractors. All of Little Rock, Ark.

Architectural concrete is ideal for modern waterworks buildings—and all other municipal structures. It can be used to create functional yet distinctive buildings like the General Waterworks plant in Pine Bluff, Ark. above. Such structures stand out as symbols of sanitation and good management and are a source of community pride.

Architectural concrete meets structural requirements for strength, durability and firesafety. And it can be molded economically into ornamentation of any style or period.

Architectural concrete is economical too. It is moderate in first cost, costs less to maintain and renders long years of service. These add up to ***low annual cost.***

PORTLAND CEMENT ASSOCIATION

33 W. Grand Ave. / Chicago 10, Ill. / A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work

(Continued from page 86 P&R)

index which appeared in 1888 and 1897.

Building on this foundation, he also assembled a library of source information on water supply history which served to document his notable history of water purification, *The Quest for Pure Water*, which was published by AWWA in 1948. In addition, he wrote a number of books and articles on water works and sanitary engineering subjects, including two on British sewage and refuse disposal.

Elbert J. Taylor, head of the Philadelphia Water Bureau from 1946 to 1952 and assistant to the chief engineer thereafter, died at his home on Jan. 22. He was 57. He had served as an AWWA director from the Pennsylvania Section in 1950–53. Before joining the Philadelphia bureau he had been associated with the consulting firm of Morris Knowles for over 20 years.

C. C. Ruchhoft, widely known sanitary engineer director of the Sanitary Engineering Center maintained by the Public Health Service at Cincinnati, died at his home in that city on Jan. 19. Illness had forced his retirement last Jul. 1. The author of over a hundred technical and research papers, he was active in and had received honors from many societies, including the American Chemical Society (Eminent Chemist Award of Cincinnati Section), Federation of Sewage & Industrial Wastes Assns. (Emerson Medal), and Technical and Scientific Society Council of Cincinnati (acclaimed that city's "outstanding engineer" in 1951). He was also a member of AWWA, the Society of American Bacteriologists, and numerous governmental committees, such as that on radiation protection of the Bureau of Standards and that on sewage disposal in military areas of the National Research Council. In addition, he had served as consultant to the armed forces and to the Atomic Energy Commission.

L. R. Fulmer Jr., R. D. Wood Co. sales engineer until his recall to active duty with the Navy in 1952, was pilot of the ill-fated Constellation which crashed in the Gulf of St. Lawrence recently, with loss of all 13 passengers and crewmen. Mrs. Fulmer is the former Miss Marian Jackson, daughter of Leslie A. Jackson, manager of the Little Rock, Ark., water works and secretary-treasurer of the Southwest Section AWWA. An unfortunate aftereffect of the tragedy was the auto accident which injured both Mr. and Mrs. Jackson in Tennessee, as they were on their way to Maryland to console their daughter. Although they have since returned home, both had to be hospitalized, having suffered facial lacerations and other injuries.

Alan A. Wood, president and treasurer of Alan A. Wood, Inc., died Jan. 29 at his home in Philadelphia, at the age of 63. His organization had served as sales agency for B-I-F Industries, Inc., for the Philadelphia, Washington, and Richmond, Va., areas. Other organizations served were Cleaver-Brooks Co. and Ralph B. Carter Co.

OVER 300 MUNICIPALITIES USE ACCELATOR® Treating Plants

...for less space...for less cost

...for better results

Combining mixing, coagulation and solids separation in a single unit, "ACCELATOR" plants soften, stabilize and clarify water at consistently higher rates. This means more capacity from smaller units and substantial savings in construction and operating costs. "ACCELATOR" treating plants produce better water with more complete removal of bacteria and algae, turbidity, color, iron and hardness. Units can be engineered for any capacity. Write for complete catalog information or see your Consulting Engineer.

Typical cities using "ACCELATOR" Treating Plants include: *Benton Harbor, Mich. • Casablanca, Morocco Cairo, Egypt • Columbia, S. C. • Charleston, W. Va. Decatur, Ill. • El Centro, Cal. • Fargo, N. D. • Kelso, Wash. Sao Paulo, Brazil, S. A. • Tampa, Fla. • Wichita Falls, Tex.*

The one company offering engineered equipment for all types of water and waste processing—coagulation, precipitation, sedimentation, flotation, filtration, ion exchange and biological treatment.

5684

INFILCO INC.

925 South Campbell Ave., Tucson, Arizona

Field offices in principal cities in North America

Correspondence

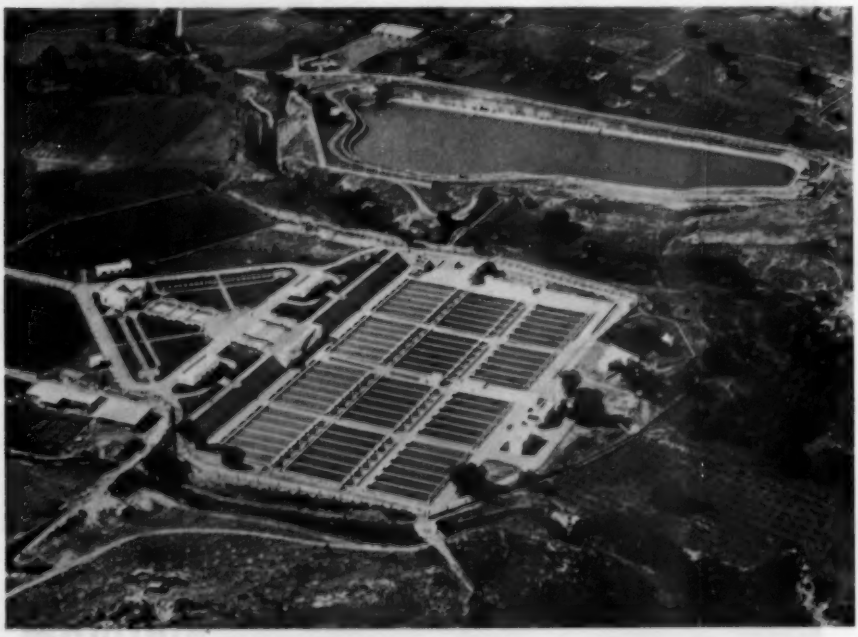
Place in the Sun

To the Editor:

We appreciated your lines on "Making the Water Works Interesting and Attractive" ("Silent Service Is Not Enough!" in December 1954 JOURNAL, p. 1305). We are pleased to see that our American colleagues give special attention to the architecture of their plants.

Please note the attached photographs of a recent plant in Algeria, the Oran Water Works, which our firm constructed in 1947–50. It is a 2.5-acre, 30-mgd slow sand filtration plant erected in a desert, as shown in the aerial view (below).

This station looks more like a watering garden than an industrial plant. Century-old olive trees have been saved and integrated in the decorative scheme of the plant. The manager's house and gardens are on the left, the laboratories and buildings for maintenance workers are on the right.



(*Continued on page 92 P&R*)

NEW
SMITH TAPPING MACHINES FOR TAPS 2" THRU 12" INCLUSIVE

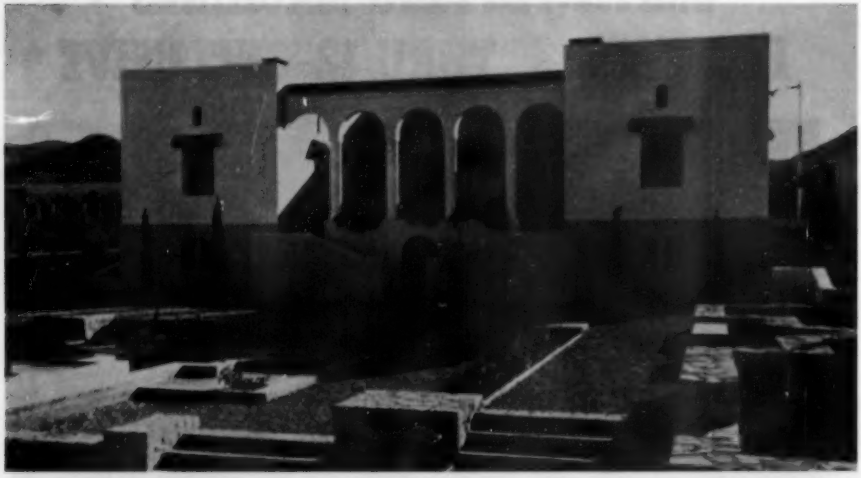
The NEW Smith S-54 Tapping Machine is the most modern, efficient and economical machine available. The Machine is used with Tapping Sleeves, Hat Flanges, Saddles and Tapping Valves to make 2" through 12" connections under pressure to Cast Iron, Cement-Asbestos, Steel and Reinforced Concrete Pressure pipe. Features: 1. Positive automatic feed insures correct drilling and tapping rate. 2. Travel is automatically terminated when tap is completed—cutter and shaft cannot overtravel. 3. Telescopic shaft reduces overall length. 4. Mechanism is housed in heat treated Aluminum Case filled with lubricant. 5. Stuffing Box and Packing Gland is accessible without disassembling machine. Line pressure cannot enter machine case. 6. Extra large diameter telescopic shaft add strength and rigidity. Timken radial—thrust bearings maintain alignment, reduce friction and wear. 7. Worm gearing operates in lubricant, torque is reduced to the minimum. 8. Cutters have replaceable Flat and Semi-V alternate teeth of High Speed Steel or Tungsten Carbide. 9. Flexibility: Hand Operated Machines can be converted to Power Operation by interchanging worm gearing. Bulletin T54 sent on request.

53

THE A.P. SMITH MFG. CO.
EAST ORANGE, NEW JERSEY

Correspondence

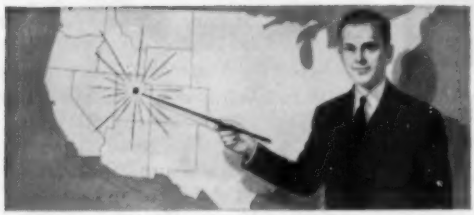
(Continued from page 90 P&R)



Two additional photographs (top; center) show the manager's house and the view of the gardens and swimming pool from it. The final view (p. 94) is of the fountain showpiece, a ceramic creation of the sculptor Bizette-Lindet, who

(Continued on page 94 P&R)

NEW UTAH PLANT to speed low cost delivery of USS quality water PIPE



Strategically centered to reach you with the greatest possible efficiency, Consolidated Western's new plant will produce and deliver the highest quality electric welded steel pipe at the lowest possible cost. Sizes available include 4" to 40" diameters in lengths up to 50 feet to meet the needs of domestic water systems, industrial and agricultural installations. New long length Consolidated Western pipe is engineered and manufactured to provide (1) uniform circumference and roundness insuring perfect fit-up in the field; (2) uniform diameter and wall thickness coupled with high strength and ductility for maximum economy.

Because United States Steel emphasizes quality control from mine to mill to finished steel . . . its consistently high-quality steel pipe is in demand the world over. A substantial portion of the pipe for the water development of the West has been manufactured by Consolidated Western. For 100 years, the Consolidated Western Steel Division of United States Steel has pioneered the fabrication, erection and manufacture of pipe, structural steel, plate products and mechanical equipment — constantly proving that only steel can do so many jobs so well.

Consolidated Western Steel Builds New Pipe Plant at Provo, "The Hub of the West"... to Better Serve a Growing, Building West

MODERN WESTERN WATERWAY. Sections of welded steel water pipe were supplied by Consolidated Western Steel to build the great Mokelumne Aqueduct . . . part of which is shown here near Stockton, California. Supplying water to the East San Francisco Bay region, the Mokelumne is one of many Consolidated Western pipe lines serving the growing West.

CONSOLIDATED WESTERN STEEL

Sales Offices: Los Angeles, San Francisco, Fresno, Bakersfield, California, Phoenix, Arizona, Seattle, Washington, Houston, Texas.

DIVISION

USS

UNITED STATES STEEL

Correspondence

(Continued from page 92 P&R)

won the First Grand Prix de Rome. I hope these views will interest you.

C. CHABAL

C. Chabal & Cie.
34 Rue Ampere
Paris, France
Jan. 24, 1955

Beauty of course, but that ain't all. And we're afraid it will take a good many more years of drought before American water works men will rate private swimming pools too. Not because they don't earn them right now, but because their customers don't realize it. It takes something like putting the "eau" in oasis to double the "s" in desert.—ED.

Hero Today and Goner Tomorrow

To the Editor:

It seems to me that the AWWA has been overlooking something and that the East German Water Works Journal (*Wasserwirtschaft-Wassertechnik*) is way ahead. The directors of our Association and the various other dignitaries are certainly entitled to at least the same considerations as their East German contemporaries.

One of the directors of the East German Journal, for instance, is "Held der Arbeit [Hero of Labor] Prof. Dr. Eng. Hans Denert." Others are "Verdienter Erfinder [Meritorious Discoverer] Eng. Chem. Georg Schulz" and "Verdienter Techniker des Volkes [Meritorious Technician of the People] Prof. Dr. phil. Arthur Spliffgerber."

I am sure that you will hurriedly take action to correct the oversight and induce the members of the Board to establish similar or better titles for everyone worthy. How nice would it be, for instance, to address Mr. Brush as "Meritorious and Mighty Keeper of the Pouch of the People Doctor Engineer William W. Brush." You could get up quite a variety of titles which would cover every officer and director of the AWWA. Of course, it may take some space in the JOURNAL, but I am sure "Percolation and Runoff" could elaborate and establish the practice. No doubt the newspapers would soon take it over and you would have another angle in your public relations.

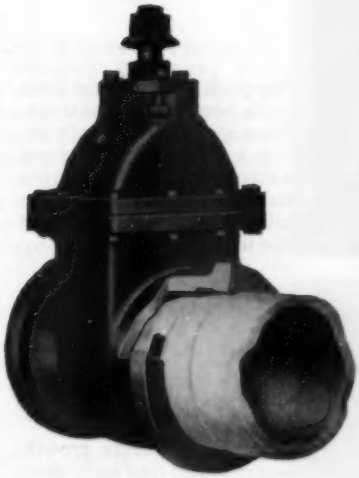
W. RUDOLFS

Huzarenlaan
Joppe (Deld), Netherlands
Jan. 20, 1955

Much as we appreciate Dr. Rudolfs' suggestion of P&R as beknighter of counterpropagandist titularies, we feel we must decline, as much for fear of libel suits as anything else. Besides, this being a free country, its water works men ought to choose their own titles. Willing Water, for instance, has already decided that he is hereafter to be addressed as "Professor of the Incomparable Importance of Water and Doctor of Derring-do" —Willie, that is, for short.—ED.

Now Ring-Tite Joints

for RENSSELAER VALVES



Rensselaer Valve with "O" Ring Seal and Ring-Tite Joint.

Rensselaer Valve Co. in cooperation with Johns-Manville has adapted Gate Valves and Hydrants to the Ring-Tite Joint, developed by Johns-Manville for Transite Pipe. The first experimental installation of Ring-Tite valves was made in July 1953 at Mattapoisett, Massachusetts.

FAST AND SURE INSTALLATION

Rensselaer Ring-Tite Gate Valves and Fire Hydrants permit quick and simple installation with Transite Pipe. No special fittings are required and labor cost is low. Ring-Tite Bells provide tight, flexible joints.

During assembly, rings are inserted in the grooves, pipe ends are lubricated and the pipe is pulled in — sliding under the rings and slipping along until movement is stopped by shoulders on the pipe. A very simple puller is used and the job is accomplished quickly and with very little effort.

At low pressures, the seal is obtained by radial compression of rubber rings. At higher pressures, rings are wedged in the grooves tighter by the pressure.

Rensselaer Gate Valves with Ring-Tite Ends are available in sizes 4" through 12" for Class 150 Transite Pipe.

Rensselaer VALVE CO. TROY, N. Y.

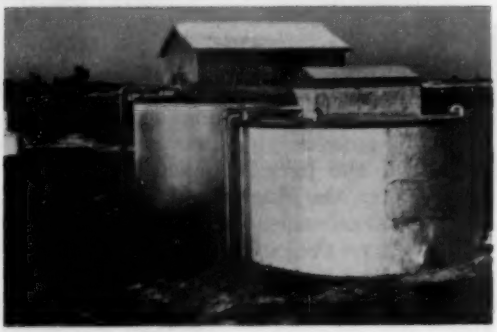
GATE VALVES • FIRE HYDRANTS • SQUARE BOTTOM VALVES • CHECK VALVES • AIR RELEASE VALVES

SALES REPRESENTATIVES IN PRINCIPAL CITIES

HOLLYWOOD (Florida) ...regenerating its

1

Pumps draw sea water from wells beneath this station. Being inland, these wells deliver a partially filtered sea water. (Regenerating costs are now $25 less per million gallons than when dry salt was used.)



2

To prevent marine growths which would foul equipment, the sea water is aerated and chlorinated.

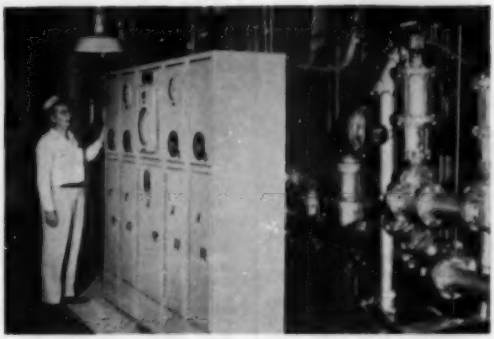
3

Sea water then passes through Permutit pressure filters (left) and is ready for regenerating the Permutit softeners (right). Sea water pumpage is kept to a minimum because high-capacity Permutit Q, used in the softeners, requires less salt for regeneration.

WATER CONDITIONING HEADQUARTERS

SAVES $32,980 A YEAR

softeners with sea water



4

City Engineer George A. Gieseke inspects the Permutit control panel. It backwashes, regenerates and rinses the 4 newest softeners and places them on the line . . . *all without aid from the plant operator!* Two men per shift operate the entire water plant.

5

Hollywood is growing fast. Their first four Permutit softeners went on the line twenty years ago. Now there are 12 . . . and plant space for more. "We're in good shape," says City Engineer Gieseke.

It's easy to see why Consulting Engineers *Reynolds, Smith & Hills* chose Permutit equipment . . . for its long service life and low operating costs. And we'll be glad to help you make sure your water supply is "in good shape" for the future. Write to: The Permutit Company, Dept. JA-3, 330 West 42nd Street, New York 36, N. Y.

PERMUTIT

CHANGES IN MEMBERSHIP

NEW MEMBERS

Applications received Jan. 1–31, 1955

Adams, Fred M., Supt., Borrigo Springs Water Co., Box 196, Borrigo Springs, Calif. (Jan. '55) *D*

Agulia, Frank P., Chemist, Alexandria Water Co., 107 N. St. Asaph St., Alexandria, Va. (Jan. '55) *MP*

Albright, Richard O., San. Engr., Clyde E. Williams & Assoc., 720 E. 38th St., Indianapolis 5, Ind. (Jan. '55) *PD*

Ballard, Denver, Water Works Supt., Wheatland Water Co., Box 383, Wheatland, Ind. (Jan. '55) *MP*

Banning Water Co., Wallace Stewart, Supt., 169 W. Ramsey St., Banning, Calif. (Corp. M. Jan. '55)

Barringer, James C., Jr., San. Engr., Evansville-Vanderburgh County Health Dept., 201 S.E. 3rd St., Evansville, Ind. (Jan. '55) *RP*

Bartlett, G. Sedley, Treas., Water Dept., Meredith Village Fire Dist., Box 24, Meredith, N.H. (Jan. '55) *M*

Basinger, Homer A., Supt., Water Works, Petersburg Water Co., Petersburg, Ind. (Jan. '55) *MRP*

Bazzini, Robert John, Sales Engr., Turbine Equipment Co., 63 Vesey St., New York 7, N.Y. (Jan. '55) *D*

Beaudry, Francis Earl, Jr., Chemist, Utilities Dept., High Point, N.C. (Jan. '55) *MP*

Beetem, W. Arthur, Chemist-in-Charge, Saratoga Office, US Geological Survey, Box 68, Albany, N.Y. (Jan. '55) *RP*

Biddle, Charles C., Design Engr., Patchen & Zimmerman, 525 Telfair St., Augusta, Ga. (Jan. '55) *PD*

Biggerstaff, Sam; *see* Engineer Assocs.

Blackshaw, George E., Mgr., Long Island Operations, New York Water Service Corp., 11 Smith St., Merrick, N.Y. (Jan. '55)

Breniman, E. H., Supt., Water Dept., Sinclair Refining Co., Box 43, Sinclair, Wyo. (Jan. '55) *MP*

Brett, Lester E., Special Repr., Transite Pipe Dept., Johns-Manville Corp., 777 Thomas St., Seattle 9, Wash. (Jan. '55) *M*

Brookville Water Dept., Walter Clever, Mgr., Brookville, Ind. (Corp. M. Jan. '55)

Brown, Orville R., Water Supt., Box 654, Whiteface, Tex. (Jan. '55) *MRP*

Butler Dept. of Water Works, Earl Greenawald, Supt., Butler, Ind. (Munic. Sv. Sub. Jan. '55) *MD*

Buzard, Joe, Supt., Area B, Islemorada, Florida Keys Aqueduct Com., Box 599, Key West, Fla. (Jan. '55) *D*

Byrne, Desmond, Water Works Engr., Municipality of Metropolitan Toronto, 199 Dunn Ave., Toronto 3, Ont. (Jan. '55)

Byrne, John H., 27830 Gilchrist Dr., Cleveland 32, Ohio (Jan. '55)

Cash, Bartley J., Supt. of Filtration, Box 65, Milledgeville, Ga. (Jan. '55) *MP*

Citizens Utilities Co. [Stamford], M. P. Griffith, Asst. Vice-Pres., Stamford, Conn. (Corp. M. Jan. '55)

Clever, Walter; *see* Brookville (Ind.) Water Dept.

Cline, Charles Wesley, Asst. Chief Engr. of Constr., Water Works, 651—14th St., N.W., Atlanta, Ga. (Jan. '55) *M*

Clouet, H. A.; *see* Rockwell, W. S., Co.

Colby, City of, Hal L. Everett, City Mgr., City Hall, Colby, Kan. (Munic. Sv. Sub. Jan. '55) *MRPD*

Corning Water Dept., Philip Grannan, Supt., Dept. of Public Works, City Hall, Corning, N.Y. (Munc. Sv. Sub. Jan. '55)

Coughlan, Francis Pierce, Jr., Asst. San. Engr., Hazen & Sawyer, 110 E. 42nd St., New York, N.Y. (Jan. '55) *RPD*

Cox, Robert Bruce, Sr. Development Engr., Aerojet-General Corp., Azusa, Calif. (Jan. '55) *R*

Creagan, L. R., Supt., Munic. Water Works, Centerville, Iowa (Jan. '55) *MRPD*

Dalessio, Joseph, Supervisor of Water Works, Real Estate Div., Kovalchick Salvage Co., 1138 Philadelphia St., Indiana, Pa. (Jan. '55) *PD*

Ditmars, Donald M., Partner, Bogert & Childs, 624 Madison Ave., New York 22, N.Y. (Jan. '55) *MRPD*

do Rego Monteiro, Jose Roberto, San. Engr., Public Works Dept., Rio de Janeiro, Brazil (Jan. '55) *MRPD*

Dunlop, John, Sales Mgr., Pipe Div., Canada Iron Foundries, Ltd., 921 Sun Life Bldg., Montreal, Que. (Jan. '55) *D*

East Brunswick Township, Joseph W. Swan, Chief Clerk, Water Dept., Box 313, South River, N.J. (Munic. Sv. Sub. Jan. '55) *PD*

Ebert, Daryl W., Assoc. Chemist, State Hygienic Lab., Des Moines Branch, 405 State Office & Lab. Bldg., E. 7th & Court, Des Moines 9, Iowa (Affil. Jan. '55) *RP*

Edstrom, J. T., Water Main Extension Supt., Water Dept., 224 N. Main St., South Bend, Ind. (Jan. '55) *MRPD*

Ellington, Fay; *see* Princeton (Ind.) Water Co.

Engineer Assocs., Sam Biggerstaff, Partner, 308 N.W. 8th St., Evansville, Ind. (Corp. M. Jan. '55) *RP*

Estherville, City of, Lester R. Sidles, Water Supt., City Hall, Estherville, Iowa (Munic. Sv. Sub. Jan. '55) *MRPD*

Evans, Paul J., Chief Chemist, US Steel Co., Gary, W.Va. (Jan. '55)

Everett, Hal L.; *see* Colby (Kan.)

Flora Water Works, A. H. Giltner, Mgr., 10 N. Center St., Flora, Ind. (Corp. M. Jan. '55)

Forrest, Marion, Member, Board of Public Affairs, Vandalia, Ohio (Jan. '55) *M*

Forrest, Tom H., San. Engr., Chicago Pump Co., 622 Diversey Pkwy., Chicago 14, Ill. (Jan. '55) *MP*

Fortune, J. Robert, Jr., Eng. Sales Repr., J. R. Fortune & Son, 646 N. Woodward Ave., Birmingham, Mich. (Jan. '55) *P*

Friese, John H., Supt. of Water, 255 Main St., White Plains, N.Y. (Jan. '55)

Garnett, Jack B., Jr. Engr., Gore & Storrie, Ltd., 1130 Bay St., Toronto, Ont. (Jan. '55).

Geneva Water Dept., J. J. Simmons, Supt., Geneva, Ind. (Corp. M. Jan. '55)

Gilbert, George E., US Air Force, MSC, JUSMG (Spain), APO 285, New York, N. Y. (Jan. '55)

Glover, George E., Project Engr., Water & Waste Equipment, Industrial Filter & Pumps Mfg. Co., 2900 Ogden Ave., Chicago, Ill. (Jan. '55) *RP*

Graham, James D., Dist. Mgr., Indiana Gas & Water Co., Inc., 120 S. Washington St., Crawfordsville, Ind. (Jan. '55)

Graham, Russell; *see* Peoria Heights (Ill.) Water Works.

Grannan, Philip; *see* Corning (N.Y.) Water Dept.

Greenawald, Earl; *see* Butler (Ind.) Dept. of Water Works

Griffith, M. P.; *see* Citizens Utilities Co. (Stamford)

Grimsley, Robert J., Sales Engr., Byron Jackson Co., 580—5th Ave., New York 36, N.Y. (Jan. '55) *RD*

Grosboll, Lorin E., Sales Repr., Mueller Co., 1136 Bolling Rd., Charlotte, N.C. (Jan. '55)

Groshans, Leonard A., Gen. Foreman, Reclamation Dept., Standard Oil Co. (Ind.), Whiting, Ind. (Jan. '55) *RP*

Gulty-Mehr, Hossein F., Chief San. Engr., Caspian Region, Public Health Cooperative of Iran, Rm. 73, Palace Hotel, Babolsar, Iran (Jan. '55) *MRPD*

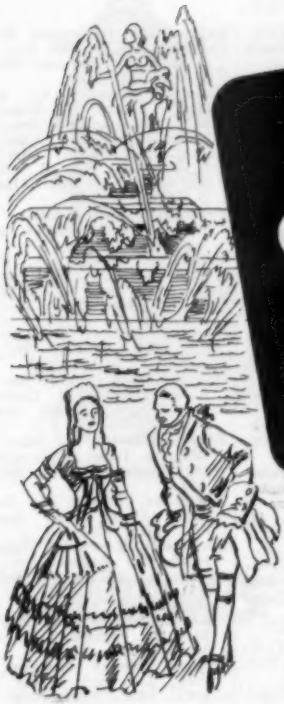
Harrington, George E., Assoc. Chemist, Dalecarlia Filtration Plant, 5900 MacArthur Blvd., N.W., Washington, D.C. (Jan. '55)

Harris, James C., Operator, Water Treatment Plant, 816—6th Ave. W., Bradenton, Fla. (Jan. '55) *P*

Hill, Richard T., Stremmel & Hill, W. Kendall St., La Fontaine, Ind. (Jan. '55)

Hooper, A. J.; *see* Maintenance Eng. Corp.

(*Continued on page 100 P&R*)



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Hoskins, Edwin Campbell, Asst. to Supt., Bureau of Water, Utilities Board, 626 S. Gay St., Knoxville, Tenn. (Jan. '55) *M*

Huibert, Gordon E., Trustee, Water Board, 182 Iroquois St., Webster, N.Y. (Jan. '55)

Hummel, Russell S., Jr., Civ. Engr., Water Works Com., Newport News, Va. (Jan. '55) *PD*

Huntington, Gurdon Parke, Jr., Engr., J. B. Wilson, 524 K. of P. Bldg., Indianapolis 4, Ind. (Jan. '55) *P*

Hyde, W. S., Div. Repr., Wallace & Tiernan Inc., 3080 Sierra Blvd., Sacramento 21, Calif. (Jan. '55)

Ingerman, Glen W., Supt., Water Works, Cambridge City, Ind. (Jan. '55) *MD*

Jacksonville, Town of, A. C. Turnage, Jr., Director, Public Utilities, Jacksonville, N.C. (Corp. M. Jan. '55) *MRP*

Jessee, Clarence H.; *see* Richlands (Va.)

Johnson, Ralph, City Mgr., La Crosse, Kan. (Jan. '55) *MRD*

Joint, William J., Office Mgr., Bureau of Water, 701 French St., Erie, Pa. (Jan. '55) *M*

Kaller, J. J., Project Engr., Univ. Endowment Lands, 5495 Chancellor Blvd., Vancouver 8, B.C. (Jan. '55) *MP*

Karpen, Raymond J., MSC, Medical Sec., Hq. 1st Army, Governors Island, N. Y. (Jan. '55)

Kearns, Earl, Supt. Water Plant, High Point, N.C. (Jan. '55) *MP*

Keyser, City of, John W. Purgitt, Water Supt., Box 70, Keyser, W.Va. (Munic. Sv. Sub. Jan. '55) *MRPD*

Kiel, William J., Supt., Water Dept., 224 N. Main St., South Bend, Ind. (Jan. '55) *M*

Kimrey, W. E., Jr., Water & Sewer Contractor, 2019 Coleman St., San Angelo, Tex. (Jan. '55) *M*

King, Lloyd H., Mgr., Florida Utilities Corp., 1052 Kentucky Ave., Winter Park, Fla. (Jan. '55)

Kolling, William J., Supt., Light, Water & Building Com., Spring Valley, Minn. (Jan. '55) *MRPD*

L'Allier, Lucien, Director, Public Works, City Hall, Montreal, Que. (Jan. '55) *M*

London Water Dept., 13 E. 1st St., Box 151, London, Ohio (Munic. Sv. Sub. Jan. '55) *MRP*

Lowe, L. Ross, Sales Engr., Kessler Co., 4 Floral Lane, North Little Rock, Ark. (Jan. '55)

Maintenance Eng. Corp., A. J. Hooper, Box 2637, Houston 1, Tex. (Assoc. M. Jan. '55)

Mason, Pie A., Comr., Water Dept., City Hall, Deer Lodge, Mont. (Jan. '55) *PD*

Matheny, H. B., Vocational Sales Mgr., Remington Rand Inc., 315—4th Ave., New York, N.Y. (Jan. '55) *MD*

Mathews, C. M.; *see* Yazoo City (Miss.) Public Service Com.

Matthias, Paul H., Civ. Engr., Dept. of San. Eng., 5117 Saratoga Ave., Washington 16, D.C. (Jan. '55)

McCammack, S. F., Supt., Water & Light, Box 914, Portland, Ind. (Jan. '55) *M*

McCauslin, John, Supt., Distr. System, 224 N. Main St., South Bend, Ind. (Jan. '55)

McCorkle, William, Supt., Water Works, Vandalia, Ohio (Jan. '55) *MPD*

McCreary, E. J., Engr., Gasoline Dept., Phillips Petroleum Co., Bartlesville, Okla. (Jan. '55)

McFarland, Daniel S., Sales Repr., Neptune Meter Co., 701 E. 3rd St., Los Angeles 13, Calif. (Jan. '55) *D*

McGee, Donald E., Supt., Water Dept., 3930 N. Murray Ave., Shorewood 11, Wis. (Jan. '55) *M*

McPeake, Troy W., Supt., Water Dept., City Hall, Union City, Tenn. (Jan. '55) *M*

Michaels, Robert K., Cons. Engr., A. P. & R. K. Michaels, Church & Main Bldg., Box 974, Orlando, Fla. (Jan. '55)

Michigan City Board of Trustees, Dept. of Water Works, L. L. Wheeler, Chairman, 532 Franklin St., Michigan City, Ind. (Corp. M. Jan. '55) *MP*

Minneapolis-Honeywell Regulator Co., W. H. Sisson, Industry Mgr., Industrial Div., Wayne & Windrim Aves., Philadelphia 44, Pa. (Assoc. M. Jan. '55)

Mobberly, J. S., Gen. Office Mgr., Munic. Utilities, 412 Frederica St., Owensboro, Ky. (Jan. '55) *M*

Moore, E. L. P., Design Engr., Du Pont Co. of Canada Ltd., Box 660, Montreal, Que. (Jan. '55)

Nielsen, Henry L., Jr., Pres., Nielsen Constr. Co. Inc., Warwick, N.Y. (Jan. '55) *PD*

Norman, Clyde T., Sales Engr., Johns-Manville Sales Corp., 7912 Bonhomme Ave., Clayton, Mo. (Jan. '55) *D*

Odom, John H., Florida Utilities Corp., Box 713, Apopka, Fla. (Jan. '55)

Oldfather, Sam, Vice-Pres., Water Utilities Inc., 350 N. Buffalo St., Warsaw, Ind. (Jan. '55) *MRPD*

Olivier, Gordon E., San. Engr., State Dept. of Health, Lansing 4, Mich. (Jan. '55) *MP*

Panzer, Robert R., Jr., Supt., Bldgs. & Grounds, Hanover College, Hanover, Ind. (Jan. '55) *MD*

Patrick, William E., Mgr., McGehee Water Corp., McGehee, Ark. (Jan. '55) *M*

Peoria Heights Water Works, Russell Graham, Supt., 124 W. Seiberling St., Peoria Heights, Ill. (Corp. M. Jan. '55)

Pepper, Jack H., Supt., Public Service Com., Yazoo City, Miss. (Jan. '55) *MRD*

Peralta-Rojas, Andres, Civ. Engr., National Inst. of San. Works of Venezuela, S.A., Box 179, College Stn., Tex. (Jan. '55) *RPD*

Phelan, Edward, Member, Board of Public Affairs, Vandalia, Ohio (Jan. '55) *M*

Phemister, G. P.; *see* Underwriters' Labs. of Canada

Place, Homer G., Asst. Civ. Engr., Water Dept., 215 W. Broadway, Long Beach 2, Calif. (Jan. '55) *MD*

Polkowski, Lawrence B., Instructor, San. & Hydr. Lab., Univ. of Wisconsin, Madison, Wis. (Jr. M. Jan. '55) *MRP*

Pomares, Marino L., Partner-Mgr., Culligan Soft Water Service, 3308 Highland Ave., Manhattan Beach, Calif. (Jan. '55)

Potts, J. Kenneth, Sales Repr., Mueller Co., 2801 E. 12th St., Los Angeles 23, Calif. (Jan. '55) *D*

Prescott Public Utilities Com., Supt., Prescott, Ont., (Corp. M. Jan. '55)

Princeton Water Co., Fay R. Ellington, Supt., Princeton, Ind. (Corp. M. Jan. '55) *MRP*

Purgitt, John W.; *see* Keyser (W.Va.)

Quinlan, Robert W., City Mgr., City Hall, Midwest City, Okla. (Jan. '55) *MRPD*

Ramey, Jesse C., Asst. San. Engr., Water Dept., 323 County-City Bldg., Seattle 4, Wash. (Jan. '55) *P*

Recob, Orville E., Sales Engr., Sabestian Diesel Equipment Co., 1801 Joplin St., Joplin, Mo. (Jan. '55)

Regadanz, Bruce E., Foreman, Verde Filter Plant, Scottsdale, Ariz. (Jan. '55) *PD*

Richlands, Town of, Clarence H. Jessee, 215 Railroad Ave., Richlands, Va. (Munic. Sv. Sub. Jan. '55) *PD*

Rockwell, W. S., Co., H. A. Clouet, Mgr., Valve Div., 200 Eliot St., Fairfield, Conn. (Assoc. M. Jan. '55)

Rogers, Henry Morgan, Vice-Pres., Lockwood Greene Engrs., Inc., 1020 Montgomery Bldg., Spartanburg, S.C. (Jan. '55) *P*

Rogers, Joe B., Office Mgr., Water Dept., 359 W. Territorial Rd., Battle Creek, Mich. (Jan. '55)

Ryan, Roy, Pres., Roy Ryan Sons Co. Inc., 1400 Grove St., Evansville, Ind. (Jan. '55)

St. John, Hayden H., Supervising Engr., Lockwood Greene Engrs., Inc., 1020 Montgomery Bldg., Spartanburg, S.C. (Jan. '55) *P*

St. Louis County Water Co., W. Victor Weir, Pres., 6600 Delmar Blvd., University City 5, Mo. (Corp. M. Jan. '55) *MRPD*

Scholz, Henry R., Asst. Supt., Water Dept., 255 Main St., White Plains, N.Y. (Affil. Jan. '55)

Sellers, Edward L., Supt., Water Dept., Battle Creek, Mich. (Jan. '55) *MPD*

Sewell, Don E., Cons. Engr., Don E. Sewell & Assocs., 10 Drayton St., Savannah, Ga. (Jan. '55) *P*

Sheer, Donald, Pres., Board of Public Affairs, Vandalia, Ohio (Jan. '55)

Shilling, William C., Design Engr., Water Dept., Box 1160, Austin, Tex. (Jan. '55) *MR*

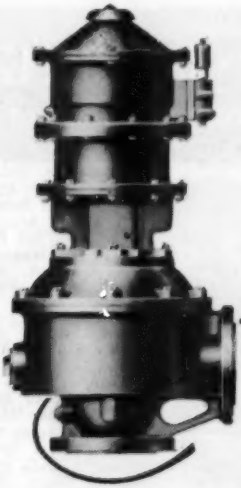
Sidles, Lester R.; *see* Estherville (Iowa)

Simmons, J. J., Supt., Water Works, Geneva, Ind. (Jan. '55) *MD*

Sisson, W. H.; *see* Minneapolis-Honeywell Regulator Co.

Sites, Clarence H., Asst. Engr., County Health Dept., 201 S. E. 3rd St., Evansville, Ind. (Jan. '55) *P*

(*Continued on page 102 P&R*)



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Smith, James J., Comr., Passaic Valley Water Com., 27 Knickerbocker Ave., Paterson, N.J. (Jan. '55)

Smith, Robroy A., Sales Engr., Yardley Plastics Co., 142 Parsons Ave., Columbus 15, Ohio (Jan. '55) *D*

Southwell, Firmin W., Designer, Reynolds, Smith, & Hills, 227 Park St., Jacksonville, Fla. (Jan. '55) *PD*

Stewart, Boford A., Supt., Water Works, Eaton, Ind. (Jan. '55) *M*

Stewart, Wallace; *see* Banning (Calif.) Water Co.

Stoddard, Howard A., Civ. Engr., Stoddard & Karrer, 10 Bank of America Bldg., Los Banos, Calif. (Jan. '55) *RD*

Stone, Joseph X., Supt., Castroville County Water Dist., Box 658, Castroville, Calif. (Jan. '55) *MD*

Surber, V. V., Supt., Water Co. No. 1, 35192 Cedar St., Yucaipa, Calif. (Jan. '55) *MRPD*

Swan, Joseph W.; *see* East Brunswick (N. J.)

Taylor, Harry L., Water Works, Ridgeville, Ind. (Jan. '55) *M*

Thompson, James Greer, 5411 El Parque, Long Beach 4, Calif. (Jan. '55)

Thomsen, Roger K., Utilities Engr., Water Dept., Municipal Bldg., Vancouver, Wash. (Jan. '55) *D*

Trainer, Robert S., Contracting Engr., Bethlehem Steel Corp., 25 Broadway, New York 4, N.Y. (Jan. '55) *D*

Turnage, A. C., Jr.; *see* Jacksonville (N.C.)

Turnbull, John M., Plant Chemist, International Salt Co., Myers, N.Y. (Oct. '54) *P*

Underwriters' Labs. of Canada, G. P. Phemister, Engr., Fire Protection Div., Box 38, O'Connor Postal Stn., Toronto 16, Ont. (Corp. M. Jan. '55)

Valentine, Martin J., Supt., Water Dept., 318 Freemont St., Whitewater, Wis. (Jan. '55) *MD*

Van Heuvelen, W., Director, Div. of Water Pollution Control, State Health Dept., 814—17th St., Bismarck, N.D. (Jan. '55) *RP*

Veenstra, H. Robert, Project Engr., Stanley Eng. Co., Hershey Bldg., Muscatine, Iowa (Jan. '55) *RPD*

Vicentini G., Jorge, San. Engr., Ministerio de Obras Publicas, Aptdo. 304, Caracas, Venezuela (Jan. '55)

Vorndran, August F., Jr., Consultant, 994 Salt Rd., Box 376, Webster, N.Y. (Oct. '54) *MRPD*

Waldmeyer, Trevor, Water & Effluent Chem. Engr., Albert E. Reed & Co. Ltd., Aylesford Paper Mills, Larkfield, Kent, England (Jan. '55) *MRP*

Ward, Sylvester E., Asst. Treas., Bound Brook Water Co., 17 Maiden Lane, Bound Brook, N.J. (Jan. '55)

Warren, Louis C., Supt., Water Works, Roanoke, Ind. (Jan. '55) *MD*

Warren Water & Light Dept., Max E. Williams, Water Works Supt., Warren, Ind. (Corp. M. Oct. '54) *M*

Washburn, L. A., Contractor, West Lafayette, Ind. (Jan. '55)

Waugh, Harvey C., Vice-Pres., American Water Softener Co., 4th St. & Lehigh Ave., Philadelphia 33, Pa. (Jan. '55) *P*

Webb, Arthur Hubert, Asst. Civ. Engr., Albert A. Webb Assocs., 3788 McCray St., Riverside, Calif. (Jan. '55) *RD*

Webb, Ernest N., Secy., Albert A. Webb Assocs., 3788 McCray St., Riverside, Calif. (Oct. '54) *RD*

Welcomer, Charles E., Water Works Engr., Air Depot, Middletown, Pa. (Jan. '55) *MRP*

Wheeler, L. L.; *see* Michigan City (Ind.) Board of Trustees

Williams, Lonnie C., Jr., Engr., Dept. of Public Utilities, High Point, N.C. (Jan. '55) *MRPD*

Williams, Max E.; *see* Warren (Ind.) Water & Light Dept.

Yazoo City Public Service Com., C. M. Mathews, Asst. Supt., 119 W. Commercial St., Yazoo City, Miss. (Corp. M. Jan. '55) *MRD*

Yost, Robert L., Secy.-Treas., Yost Constr. Co. Inc., RR No. 1, Decatur, Ind. (Oct. '54) *PD*

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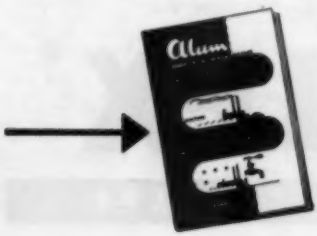

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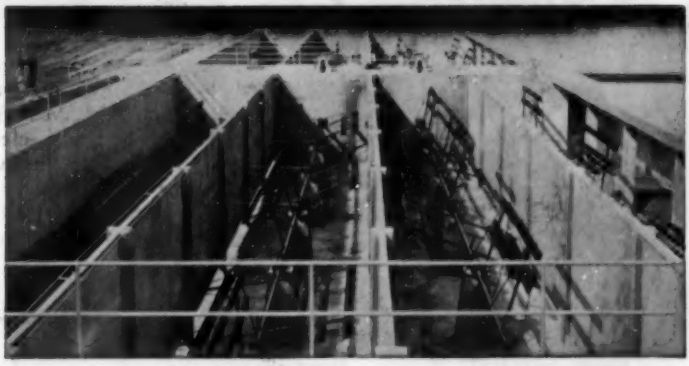

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Paris, Tennessee

Spinks

Service Lines

A records management manual is offered by Dolin Metal Products, Inc., 317–34 Lexington Ave., Brooklyn 16, N.Y. Written by management consultant Herman Limberg, the manual discusses a planned procedure for record keeping. It also includes catalog information on Dolin metal transfer cases and other record storage equipment.

A new general catalog of Fischer & Porter Co. instruments is available on request from the company at Hatboro, Pa. Known as Catalog 1, the 12-page booklet contains descriptive information on flow, pressure, liquid level, and other measuring instruments, control panels, and chlorination equipment.

"A Solution to the Problem of Deposit in Piping Systems" is suggested by Dowell Inc., Box 536, Tulsa 1, Okla. The folder discusses flooding the line with inhibited solvents, using a pipeline "pig" (combining solvent and mechanical brushing action), and, for the hardest scales, a pipeline "mole" (jetting solvents against pipe walls at pressures up to 3,500 psi.

Screening equipment for water, sewage, or industrial wastes is the subject of 28-page Book 2587 of Link-Belt Co., Dept. 127, 307 N. Michigan Ave., Chicago 1, Ill. Trash, coarse, and fine screens in various applications are described and shown.

Civic pollution control campaigns will find useful data in a 32-page booklet entitled "Clean Water . . . and How to Get It." This booklet, GEA-6096, was prepared by General Electric Co., Sche-

(Continued on page 106 P&R)

7 WAYS BETTER!

For installing corporation stops under pressure, choose the safest, surest, most easily-handled and, without sacrifice of inherent strength or quality of material, the lightest corporation tapping-machine ever made. Safe . . . because there is no danger of the drill and tap being blown out under pressure and because it offers more positive, non-slip pipe gripping action. It's compact, too . . . ideal for making taps where space is limited. All of these outstanding qualities add up to lower cost of operation. It's the Welsbach-Kitson Corporation Tapping Machine—an improved model of the Smith-Shelly Tapping Machine. Insist on Welsbach-Kitson . . . for safety, quality and simplicity.

THE WELSBACH CORPORATION

KITSON VALVE DIVISION

Westmoreland & Stokley Sts. • Philadelphia 29, Pa.

Service Lines

(Continued from page 104 P&R)

nectady 5, N.Y., to furnish the necessary background information to those working to obtain needed sewage treatment plants.

Butterfly valves are the subject of Bul. 650-L1 of Builders-Providence, Inc., 345 Harris Ave., Providence, R.I. The model BV utilizes a rubber seat and can be equipped with any of six different types of operators.

Draining hydrants with the aid of the "One-Minute" hydrant jet drain is described in a leaflet distributed by Ellis & Ford Mfg. Co., 2423 Goodrich Ave., Ferndale 20, Mich. The drain makes use of a battery-powered air compressor which can be operated from the service vehicle battery to force the water out of the hydrant. The unit was formerly marketed by the Jet Drain Eng. Co. of Saginaw, Mich.

A flotation method of removing suspended matter and chemical flocs is incorporated by Chain Belt Co. in its new "float-treat system." The system is explained in a 20-page booklet, Bul. 54–82, which may be obtained from Dept. PR of the company at Milwaukee 1, Wis. The operating principle employs the injection of air into recirculated effluent to "float" suspended particles.

Short-body fittings of Warren Foundry & Pipe Corp. are described and their dimensions given in an 8-page booklet available from Warren Foundry & Pipe Corp., 55 Liberty St., New York 5, N.Y.

A municipal supplies catalog featuring a wide variety of leak detectors and pipe locators, as well as other distribution system tools and supplies, may be obtained from W. S. Darley & Co., 2810

(Continued on page 108 P&R)

BELL JOINT LEAK CLAMPS
GASKET SEALER COMPOUND
C-I-60 CAST IRON BOLTS

Carson glands and bolts made of corrosion-resistant C-I-60 cast iron—last as long as cast iron pipe. Glands accommodate variations in pipe dimensions, insure uniform compression of rubber gasket.

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(Fluosilicate)

Inquiries Invited!

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DE LAVAL pumps America's water...

These five De Laval centrifugal pumping units, each consisting of two pumps in series, are installed in the Hays Mine Station of the South Pittsburgh Water Company. The unit in the foreground is designed for 5,400 gpm against a total head of 395 ft. at 1,200 rpm and is driven by a 600 hp motor. The other four units are identical, each designed for 9,000 gpm against a total head of 395 ft. at 1,200 rpm, and are each driven by a 1,000 hp motor.

More than 80% of America's cities depend on De Laval pumps to meet their water needs efficiently and economically. De Laval municipal pumping units range in capacity from 100 thousand to 100 million gallons per day.

NOTE:

Have you considered the dollars and cents savings you can make by replacing your old pumps with new, more efficient De Laval units? Write to De Laval for Pump Fax bulletin which includes a valuable "power savings" chart.

DE LAVAL *Centrifugal Pumps*

DE LAVAL STEAM TURBINE COMPANY

822 Nottingham Way, Trenton 2, New Jersey

DL 2668A

Service Lines

(Continued from page 106 P&R)

Washington Blvd., Chicago 12, Ill. The 100-page catalog, No. 152, also includes listings of products for other municipal departments.

Engineering tests of soils, concrete, asphalt, and construction materials can be made with apparatus described in the 104-page catalog issued by Soiltest, Inc., 4520 W. North Ave., Chicago 39, Ill.

Reprints of a technical paper on the "Effect of Alloying and Impurity Elements in Magnesium Cast Anodes" may be obtained from the Magnesium Dept., Dow Chemical Co., Midland, Mich. The authors, who are Dow metallurgists, have found that cathodic protection data gathered from salt water corrosion tests cannot be generalized. As a result, new limits are established for impurities in magnesium anodes.

The "Aeroflotor," a flotation unit for the air-entraining of suspended particles, is described in a folder, Bul. WC-119, available from Graver Water Conditioning Co., 216 W. 14th St., New York 11, N.Y.

Activated-silica sol jar tests can be conducted in accordance with a procedure outlined by a Philadelphia Quartz Co. data sheet. Requests should be addressed to the company at Public Ledger Bldg., Philadelphia 6, Pa.

"The Palo Retort," an occasional publication of Palo Laboratory Supplies Inc., 81 Reade St., New York 7, N.Y., features laboratory equipment and information.

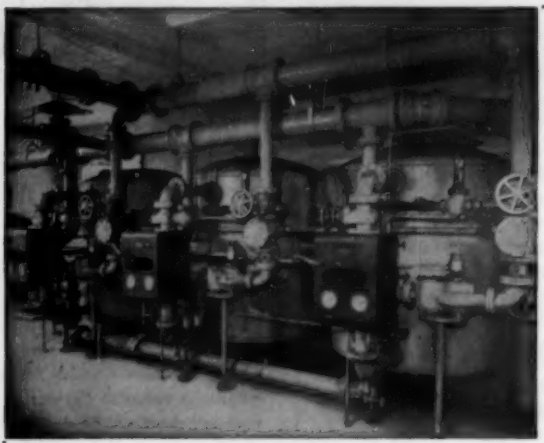

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Photo on left shows a typical H & T fully automatic, municipal, zeolite water softening plant producing clear, iron free, soft water.

Operation of this automatic water treatment plant is by our electrically operated *poppet* type multiport valves—the valves which provide unequalled performance.

If you have a water problem of any size or type—write us. With over 50 years of experience—conditioning water—We Can Help You

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The new HAYS Model B Tapping Machine, now made of High Strength aluminum alloy, is light, compact, efficient. The HAYS Machine takes up less room in the ditch, requires fewer operations, is easier to handle, easier to operate, speeds up installation of all standard makes of corporation stops.

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- Renewable bearing bronze feed yoke insert
- No disassembly to insert Corporation Stop
- Complete with chest

HAYS

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HAYS MANUFACTURING CO.

ERIE, PA.

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(See Prof. Services, pp. 55–60)

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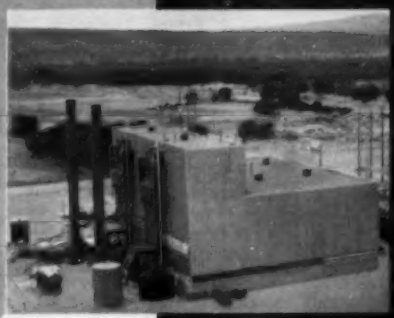
four different water supplies from one water treatment plant by GENERAL FILTER

The Plains Electric Generation and Transmission Co-operative recently completed at Algodones, New Mexico, provides 30,000 kilowatts per hour to Southwest consumers.



A water treatment plant capable of providing suitable water in sufficient quantities for four different supplies was required by the consulting engineers:

- COOLING WATER for the condensation of turbine steam.
- SANITARY WATER for drinking and sanitation.
- MAKE-UP WATER for the boilers.
- SERVICE WATER for fire protection and general utility.

With the system installed one operator can check, alter and control the treatment process from a master control panel . . . confident of complete dependability . . . minimum maintenance.

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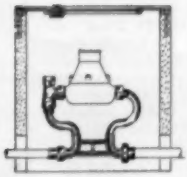

With a Ford Coppersetter, or a Ford Linesetter, you can eliminate as many as six pipe joints, two risers, four ells, one pipe coupling, one meter coupling and possibly a valve. In so doing, you raise your meter from 3" to 36" above your service line, depending upon the model used. Positive alignment is maintained when meters are changed.

Copper and bronze construction add extra years of life. Hydraulic efficiency is improved.

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Darling Valve & Mfg. Co.
Kennedy Valve Mfg. Co.
M & H Valve & Fittings Co.
Mueller Co.
Philadelphia Gear Works, Inc.
Henry Pratt Co.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.

Valves, Float:
James B. Clow & Sons
Henry Pratt Co.
Ross Valve Mfg. Co., Inc.

Valves, Gate:
Chapman Valve Mfg. Co.
James B. Clow & Sons
Crane Co.
Darling Valve & Mfg. Co.
Dresser Mfg. Div.
Kennedy Valve Mfg. Co.
Ludlow Valve Mfg. Co., Inc.
M & H Valve & Fittings Co.
Mueller Co.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.
R. D. Wood Co.

Valves, Hydraulically Operated:
Chapman Valve Mfg. Co.
James B. Clow & Sons
Crane Co.
Darling Valve & Mfg. Co.
DeZurik Shower Co.
Kennedy Valve Mfg. Co.
M & H Valve & Fittings Co.
Mueller Co.
Philadelphia Gear Works, Inc.
Henry Pratt Co.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.
R. D. Wood Co.

Valves, Large Diameter:
Chapman Valve Mfg. Co.
James B. Clow & Sons
Crane Co.
Darling Valve & Mfg. Co.
Kennedy Valve Mfg. Co.
Ludlow Valve Mfg. Co., Inc.
M & H Valve & Fittings Co.
Mueller Co.
Henry Pratt Co.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.
R. D. Wood Co.

Valves, Regulating:
DeZurik Shower Co.
Foster Eng. Co.
Mueller Co.
Henry Pratt Co.
Ross Valve Mfg. Co.

Valves, Swing Check:
Chapman Valve Mfg. Co.
James B. Clow & Sons
Crane Co.
Darling Valve & Mfg. Co.
M. Greenberg's Sons
M & H Valve & Fittings Co.
Mueller Co.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.
R. D. Wood Co.

Waterproofing
Inertol Co., Inc.

Water Softening Plants: see Softeners

Water Supply Contractors:
Layne & Bowler, Inc.

Water Testing Apparatus:
Wallace & Tiernan Inc.

Water Treatment Plants:
Allis-Chalmers Mfg. Co.
American Well Works
Chain Belt Co.
Chicago Bridge & Iron Co.
Cochrane Corp.
Dorr-Oliver Inc.
Fischer & Porter Co.
General Filter Co.
Graver Water Conditioning Co.
Hammond Iron Works
Hungerford & Terry, Inc.
Infilco Inc.
Permutit Co.
Pittsburgh-Des Moines Steel Co.
Roberts Filter Mfg. Co.
Walker Process Equipment, Inc.
Wallace & Tiernan Inc.
Welsbach Corp., Ozone Processes Div.

Well Drilling Contractors:
Layne & Bowler, Inc.

Well Screens
Johnson, Edward E., Inc.

Wrenches, Ratchet:
Dresser Mfg. Div.

Zeolite: see Ion Exchange Materials

A complete Buyers' Guide to all water works products and services offered by AWWA Associate Members appears in the 1953 AWWA Directory.

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To keep pace with the ever increasing demand for PEKRUL GATES over half a century, MORSE BROS. MACHINERY has just completed an extensive modernization program. The installation of many new machines and facilities, an increased engineering staff, and complete, new, custom re-tooling specifically for PEKRUL GATE production means...

modern design and superior engineering service...

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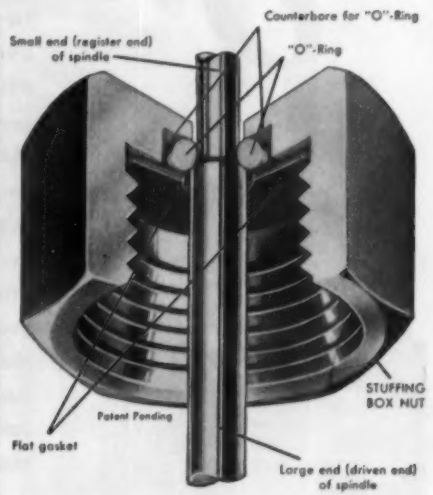
Now it has been proved...

The Exclusive Rockwell "O"-RING Water Meter Stuffing Box Nut Assembly

Eliminates Stuffing Box Leaks, Binds, Troubles, Expense...

Three Years of Proven Success In The Field

The Rockwell "O"-Ring Stuffing Box Nut Assembly was perfected over three years ago. After extensive laboratory and field tests and without any "fanfare" or publicity it has been used in Rockwell water meters built since that time. The superior performance of "O"-Ring construction is now a proven fact. It provides a permanent, leak tight seal at a very vulnerable point. And it actually improves meter performance by reducing friction at the stuffing box spindle. You get it only in Rockwell meters of all sizes and types. There's no extra cost, but a lot of extra value and satisfaction. Ask your Rockwell representative to demonstrate this great new advance in water meter construction.



Cutaway View in Enlarged Detail

HOW IT WORKS

This sectioned view shows how the "O"-Ring press-fits into a counterbore in the packing nut. The counterbore has a slightly smaller diameter than that of the "O"-Ring to hold the ring under compression. This slight compression alone seals the stuffing box spindle bottle-tight *without binding*. The nut can be force tightened with a wrench without applying any additional compression.

The Rockwell "O"-Ring assembly is also available as an economical replacement part. It is interchangeable with the stuffing box nuts on all earlier model Rockwell meters.

ROCKWELL MANUFACTURING COMPANY • PITTSBURGH 8, PA.

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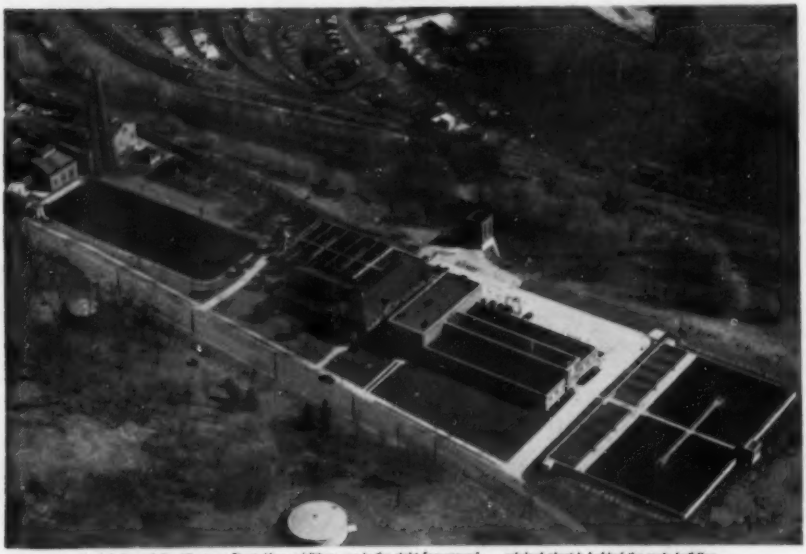
N. Kansas City, Mo. New York Philadelphia Pittsburgh San Francisco Seattle Shreveport, La. Tulsa

In water treatment problems...

you won't find identical twins

No two water treatment problems are exactly alike. The right solution to each can only be arrived at after a careful study of the local conditions. Variables such as raw water composition, rate of flow and results required automatically rule out the cure-all approach. The installation shown below is a good example of how equipment should be selected to fit the job . . . and not vice versa.



Aerial view of the Allentown Plant. New additions are in the right foreground . . . original plant is behind the main building.

Allentown, Pennsylvania

MODERNIZES EXISTING PLANT... ADDS NEW PLANT...

Faced with an expanding population and a badly overloaded water treatment plant, Allentown, Pa. called in Morris Knowles, Inc. of Pittsburgh, Pa. to design treatment facilities for 30 MGD. The Engineers first surveyed the existing facilities and found that effective use could be made of two rectangular plain sedimentation basins. Two Dorrco Flocculators, each with three rows of paddles, were installed at the head end of each basin in the twenty-five-year-old 10 MGD plant, thus greatly increasing the efficiency to prepare the water for settling and filtering. For the additional 20 MGD capacity the Engineers specified two more sets of Dorrco Flocculators to operate in combination with two SZ-7 Dorr Squarex Clarifiers each 110 ft. square. Two Dorrco Flash Mixers were also installed as well as additional filter capacity.

If you'd like more information on the complete line of Dorr-Oliver water treatment equipment, write for Bulletin No. 9141 to The Dorr-Oliver Inc., Stamford, Connecticut, or in Canada, 26 St. Clair Avenue E., Toronto 5.

Every day, nearly 8 billion gallons of water are treated by Dorr-Oliver equipment.

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Generally speaking, most Water Mains are buried beneath the Earth's surface, to be forgotten,—they are to a large extent, laid for permanency. Not only must the pipe itself be dependable and long lived,—but the joints also must be tight, flexible, and long lived,—else leaky joints are apt to cause the great expense of digging up well-paved streets, beautiful parks and estates, etc.

Thus the "jointing material" used for bell and spigot Water Mains MUST BE GOOD,—MUST BE DEPENDABLE,—and that is just why so many Engineers, Water Works Men and Contractors aim to PLAY ABSOLUTELY SAFE, by specifying and using LEADITE.

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